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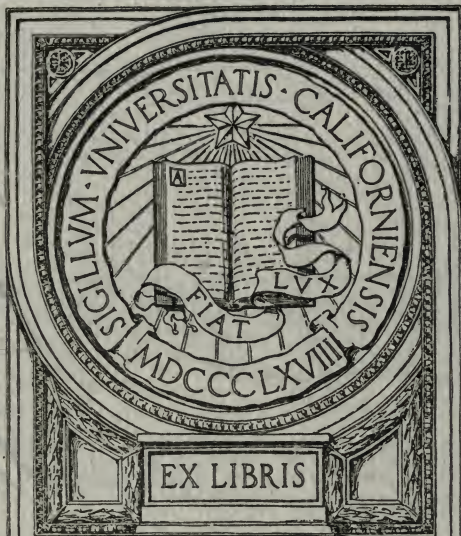
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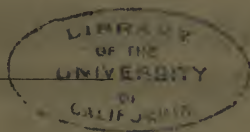
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Philosophy and Methods of Operation

OF THE
ANALYTIC SYSTEM
FOR THE
MEASUREMENT
OF
RELATIVE FIRE HAZARD
(Mercantile Classes)

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PAPERS READ BEFORE THE
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OF
CHICAGO
1908-1909

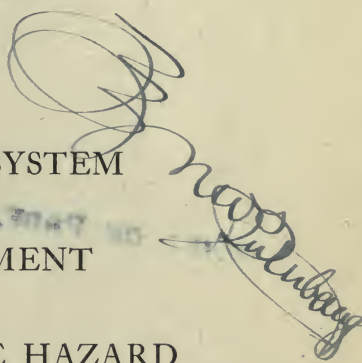


H. M. HESS

CHICAGO
1909

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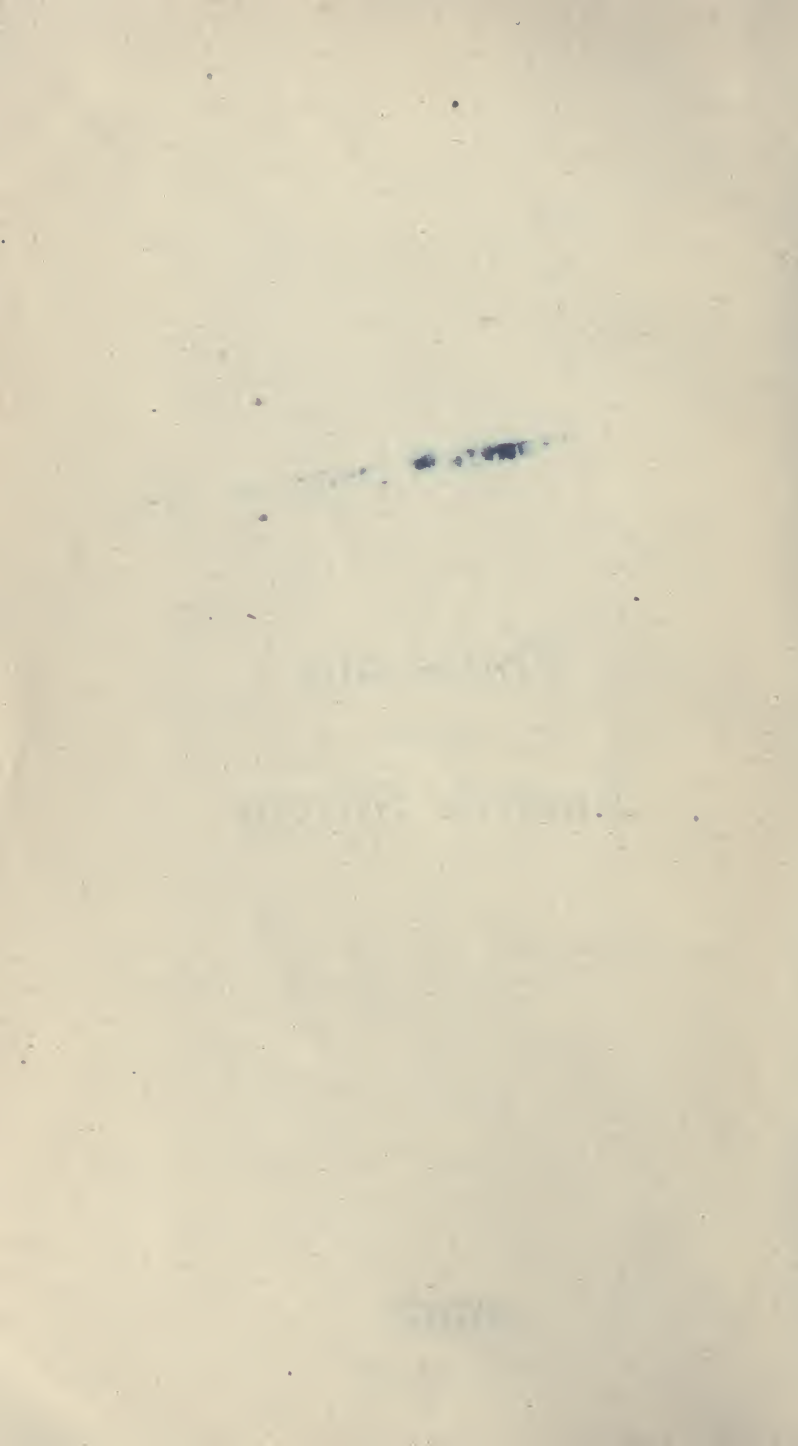
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TO THE
LIBRARY

Philosophy
OF THE
Analytic System

267077

November 24, 1908



THE PROBLEM OF FIRE INSURANCE RATING.

At the outset of this series of papers on the Analytic System I ask two favors of you. In the first place, I ask that you approach this subject with me in the attitude of the student. In teaching this system we long ago learned that a man who had not previously worked with any other system mastered the principles and details much more easily than he who had to relieve his mind and methods of old ideas and practices in order to make way for the new. So I ask you to banish from your minds all previously formed ideas of schedule rating and to assume as far as possible an open, impartial, unprejudiced attitude. If this is done, we will find that we can the more easily follow the main ideas and principles of the schedule. I shall probably say a good many things with which you will not agree in whole or in part. We would not be insurance men if we all agreed. Let us try to discover and understand the main ideas of the Analytic System, and not let any disagreement over minor points interfere with our study.

In the second place, I ask you to allow me to take the position of an expositor, rather than a defender. I am not here to defend the schedule. Doubtless as we proceed a clear understanding of its principles and details will result in the schedule defending itself. It always has. But *I* shall not ask you to agree with me that the Analytic System is the *only* system. Did the schedule need such defense, there are those more experienced than I whom your committee would have called upon. I wish merely to explain the system and shall make no argumentative attempt to deprive you of your much cherished privilege to draw your own conclusions.

The above applies to all that we shall have to say in the three or four papers on the system. Fortunately, we have been able to sub-divide the subject into its natural divisions, and tonight shall attempt to discuss only one side of a very broad subject. It is perfectly natural to treat this subject in two general parts, principles and details. In the present paper I propose to treat only of the philosophy of the system, the principles upon which it is constructed. You will have to be patient with so much theory, for we shall speak only of theory tonight, leaving the actual study of the system to the later papers. I would not thus try your patience were it not necessary to any sort of an understanding of the details of the system. Napoleon Bonaparte said, "Get your principles right, then 'tis a mere matter of detail." Tonight we shall attempt to understand the principles of the system. This is more important than detail. For if we are wrong in principle, our details are worthless.

But if we are right in principle, the working out of the right details is merely a matter of time. I hope that all who intend to study the system with us either are here tonight or will read this paper before we take up any of the later papers. Since I consider this first one necessary to a proper understanding of the others, your speaker would be seriously handicapped by a lack of understanding on your part of the principles of the system.

In our study of principles we must necessarily lift ourselves above details; let us *drop* details completely and place ourselves in a position where we can look over the broad valley of fire insurance and secure a bird's-eye view of the business, not distorted by this or that detail, which viewed close at hand looms large, but which at a distance resumes its proper relation to other details.

Fundamental Theory of Schedule Rating.

Done with introductions, we are face to face with our problem. We are studying a system that purports to analyze fire hazard and make fire insurance rates. The Analytic System is not the only system or "schedule" for making rates. Their name is legion and they have been used for many years. I have not time and it is not necessary to our study to tell you the very interesting story of schedule rating. We will be content with mentioning the first application of any schedule in the United States as far as we have been able to find out. And at the same time this incident will serve to emphasize the main object of schedule rating, namely, to make rates that will measure the fire hazard. Philadelphia has the honor of the first "schedule." In 1782 the single company then doing business suddenly decided to prohibit the insurance of houses "having a tree or trees planted before them." This was either due to the fact that shade trees interfered with the fire-fighters in case of fire, or to the danger from lightning, which was considered increased by these trees. This action resulted in the formation of a new insurance company by those that had trees planted in front of their houses. This company, of course, also carried insurance on houses without trees, and *the hazard of the shade trees was covered by a higher rate.*

Today we do not stop at shade trees alone. We have schedules of rating which make charges or credits for every tangible thing about a risk that can in any possible way affect the fire hazard. We give a building a reduction in rate if the owner removes a dangerous stovepipe. We give a reduction in rates to a whole state for a continuing small amount of losses. I wish to point out the more general classes of hazard which should be recognized by any just system of making rates and to show to what extent these hazards have been recognized by schedules previous to the Analytic System.

Three Elements Recognized.

We all know that rates on buildings are affected by their individual characteristics, such as construction, occupancy, protection, public and private, and exposures. We all know, or should know, that rates on buildings in one state are higher or lower than on buildings in another state, even though they are constructed, occupied, protected and exposed in exactly the same way. And we all know, or should know, that rates on buildings today probably are higher or lower than on the same buildings five or ten years ago. We not only find that all differences in rates can be attributed to one of these three classes of hazard, but also are of the opinion that an adequate schedule should properly recognize each and all of them.

Element of the Risk Itself.

The first one of these general classes of hazard covering construction, occupancy, public and private protection and exposure has been so long and so generally recognized and understood that we barely need to mention it. Any system that professed to be a system recognized these items in some way. Up to 1896 the schedules used in the United States at large, with the exception of a few of the larger cities, were crude minimum tariffs, which covered these items in a very general way. By means of these tariffs the special agents, by whom all rates were made at that time, were enabled to make rates that were fairly adequate for the business as it was then carried on. In 1893 the Universal Schedule was formulated, adopted and published. It also recognized these features of hazard, but in a much more complete and equitable manner than the old minimum tariffs. By these schedules the insurance business and the public have slowly been educated up to the point where a recognition of these features is accepted. Every wideawake business man today appreciates the fact that his rate depends upon these items of construction, occupancy, protection and exposure. He knows that he makes his own rate. He knows how much fire insurance premium he can save by the removal of a defect. He knows, or can find out, why he pays more or less than his neighbor, and even if his own rate is the higher, he generally recognizes its justice. The fire insurance companies are able to justify differences in rates of different buildings. Hazardous features are removed and the losses decreased. The local agent knows that his companies are committed to a certain schedule and to certain rates as made by that schedule, and his business is placed upon a business footing.

Element of Place.

Insurance men and property owners do not as generally accept or understand the second class of influences that affects fire rates.

Little is said and less done about the difference in experience and the resulting difference in rates in various parts of the country. I am not speaking now of those differences in localities which can be listed and properly charged for, such as difference in rainfall, frequency of high winds, etc. I refer rather to those unknown differences which cause a difference in experience, but which cannot be detected. A glance at the average relation of loss to amount at risk in several states shows us such a wide divergence that we are forced to provide for it in some way other than by specific charge.

The average "burning rate," or "loss cost," seems to increase as we go westward. In 22 states selected at random we find 8 states *east* of Ohio with an average burning rate of 55 cents per \$100.00 for thirteen years, and 14 states *west* of the same dividing line with an average burning rate of 79 cents, about 44 per cent higher. The average for the last twenty years shows that Wisconsin burned 72 cents for every \$100.00 at risk, and Texas 89 cents. We must acknowledge that some of this large difference is due to difference in construction or protection, to more brick buildings, more fire-proof buildings and more sprinklered risks in the territory showing the lower burning rate. There still remains, however, a difference that cannot be accounted for by any known cause. I am anticipating when I say that the Analytic System has been providing for this difference in burning rate in various localities for the last five years.

An examination of existing schedules shows that the difference in the burning rate of the several states has been recognized and provided for to a certain extent. We find that the old minimum tariffs were divided by state lines and produced different rates in the several states. This was done by a difference in basis rate alone or by a general difference in the schedules, basis rates and charges. Uniformity in charges, or relations between charges, was not attempted, and the result was an accumulation of tariffs, the comparison of which brought out inconsistencies that could not possibly be defended. The Universal Schedule, however, recognized this unexplainable difference in burning rates by providing for a 20 per cent charge when the loss exceeded 50 cents per \$100.00 of insurance for five years. Loss ratios below 55 per cent for a three-year period were also recognized by the same schedule. Any adequate system of rating, therefore, if it is to conform to statistics of losses and to what has already been partially recognized in preceding schedules, must provide some proper means of measuring the difference in burning rates in various parts of the country.

Element of Time.

The third general class of hazard with which we have to deal

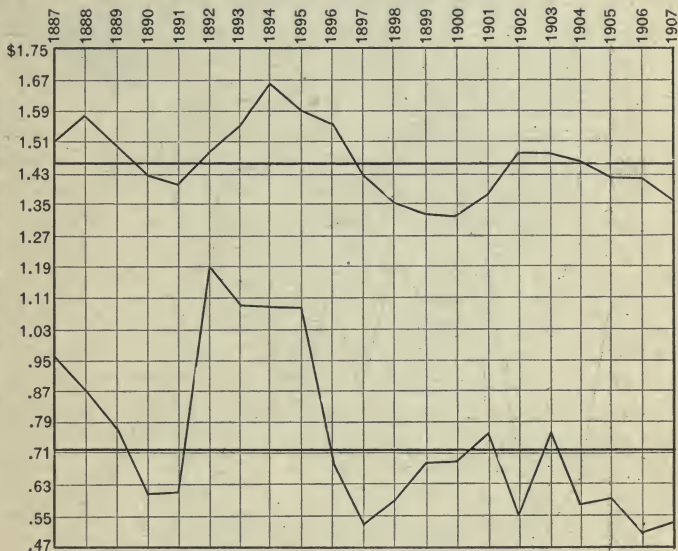


PLATE NO. 1. WISCONSIN.

Plate No. 1 shows the fluctuation of the annual burning rate or loss cost, and also of the annual rate of premium for 21 years, from 1887 to 1907, inclusive. The average burning rate or loss cost and the average rate of premium for the same period are also shown. The figures are computed for the amount of loss and the amount of premium for each \$100.00 of insurance.

Lower crooked line—annual burning rate or loss cost.

Lower straight line—average burning rate or loss cost.

Upper crooked line—annual rate of premium.

Upper straight line—average rate of premium.

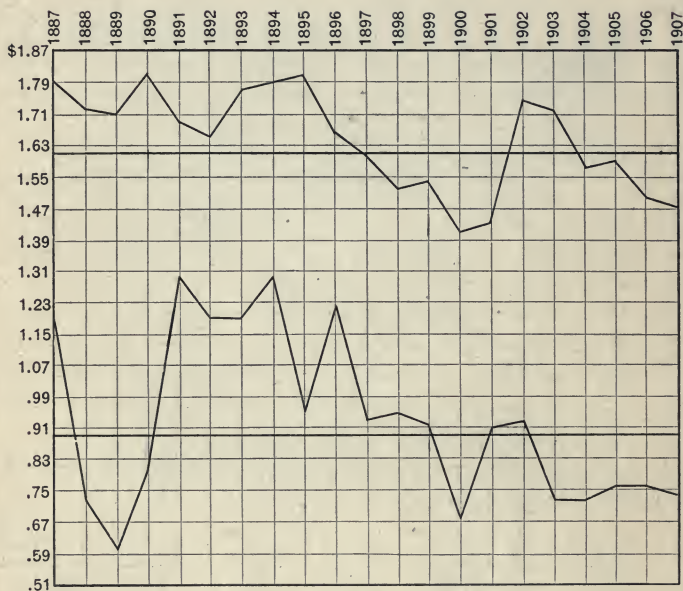


PLATE NO. 2. TEXAS.

Plate No. 2 shows the fluctuation of the annual burning rate or loss cost, and also of the annual rate of premium for 21 years, from 1887 to 1907, inclusive. The average burning rate or loss cost and the average rate of premium for the same period are also shown. The figures are computed for the amount of loss and the amount of premium for each \$100.00 of insurance.

- Lower crooked line—annual burning rate or loss cost.
- Lower straight line—average burning rate or loss cost.
- Upper crooked line—annual rate of premium.
- Upper straight line—average rate of premium.

is still more difficult to understand and is even less generally recognized than the two preceding classes. The general relation between the fire hazard of buildings does not change to any great extent. The danger from fire in a frame building badly exposed and poorly protected is just as much greater than that in a brick building unexposed and well protected, other things being equal, today as it was last year or will be next year. In the same way the general relation between the burning rates of different parts of the country does not change to any extent. The burning rate in the 14 western states mentioned shows about the same relation to that in the 8 eastern states, whether we select the thirteen years given or the thirteen years immediately preceding. Differences in hazards in buildings or in localities today were differences yesterday and will stay differences tomorrow. Yet we find our losses changing in amount from year to year according to no general law that we can discover, except the law that they *must change*. For several years our records may show heavy losses in all localities and on all classes of business. Then again the pendulum may swing the other way and for a time losses will be light and the companies prosperous and reckless. Sometimes we are able to account for these annual fluctuations by unusual weather conditions of rain or drought, or by increase or decrease of moral hazard due to business depression or prosperity. The vagaries of the weather man, the failure or success of crops and the manipulation of Wall Street have not yet permitted themselves to be subjected to scientific analysis, and we are forced to class these influences along with other factors as not to be measured by specific charges.

Element of Time Illustrated.

To illustrate the range and frequency of this ever changing experience which must be provided for in any schedule which is to be permanent we need only to turn to tabulated statistics. We find among the few classes for which figures were obtainable that the burning rate or loss cost is constantly fluctuating. In one class it ranged from 34 cents to 98 cents per \$100.00 and back again in four years; in another from 66 cents up to \$1.33 and then back to 70 cents. The experience in the various states shows the same fluctuation. In Wisconsin the burning rate has ranged from 50 cents to \$1.19 in the last twenty-one years (Plate No. 1); in Texas, from 60 cents to \$1.30 for the same period (Plate No. 2); in New York, from 26 cents to 47 cents (Plate No. 3); and in a prominent Western State, from 40 cents to 77 cents (Plate No. 4). Even the United States as a whole is subject to this same experience. In the last eighteen years the burning rate for the entire country ranged from 50 cents up to 78 cents, exclusive of the year 1906, when the San Francisco fire raised it to \$1.17 per \$100.00 (Plate No. 5).

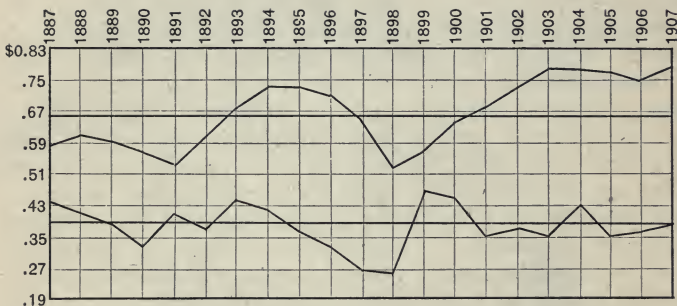


PLATE NO. 3. NEW YORK.

Plate No. 3 shows the fluctuation of the annual burning rate or loss cost, and also of the annual rate of premium for 21 years, from 1887 to 1907, inclusive. The average burning rate or loss cost and the average rate of premium for the same period are also shown. The figures are computed for the amount of loss and the amount of premium for each \$100.00 of insurance.

Lower crooked line—annual burning rate or loss cost.

Lower straight line—average burning rate or loss cost.

Upper crooked line—annual rate of premium.

Upper straight line—average rate of premium.

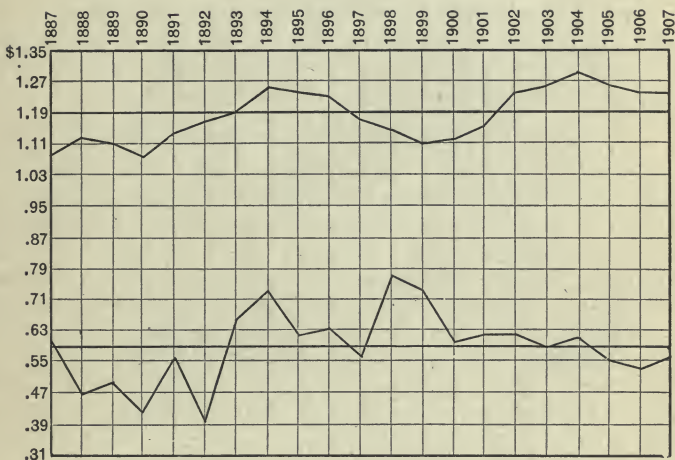


PLATE NO. 4. WESTERN STATE.

Plate No. 4 shows the fluctuation of the annual burning rate or loss cost, and also of the annual rate of premium for 21 years, from 1887 to 1907, inclusive. The average burning rate or loss cost and the average rate of premium for the same period are also shown. The figures are computed for the amount of loss and the amount of premium for each \$100.00 of insurance.

- Lower crooked line—annual burning rate or loss cost.
- Lower straight line—average burning rate or loss cost.
- Upper crooked line—annual rate of premium.
- Upper straight line—average rate of premium.

And furthermore, an examination of these statistics shows us that these extremes do not generally occur close together in point of time. A period of high burning rate lasts for several years and is followed by several years of low burning rate, or vice versa. This becomes apparent when we compare the average burning rates for different five year periods. We find in the Western State, for instance, that in 1903 the previous five years show a burning rate of 66 cents, while in 1908 the previous five years show 57 cents, or nearly 15 per cent lower (Plate No. 6). We cannot ignore such fluctuations, if we will, without ultimate harm, and a schedule to be adequate and permanent must provide for them.

Previous Recognition of Element of Time.

Pursuing our inquiry further, we ask what attempt has been made in the past to recognize these changes in experience by proper changes in rates. An examination of the average rate for the various classes and states and nation shows us beyond question that rates have fluctuated about as much as the amount of loss. For the same classes on which we quoted the burning rate and the same period of years we find the average rate ranging from \$1.93 to \$2.54 in one case, and from \$1.82 to \$2.94 in the other. In Wisconsin the average rate ranged from \$1.32 to \$1.66 (Plate No. 1); in Texas, from \$1.41 to \$1.81 (Plate No. 2); in New York, from 52 cents to 78 cents (Plate No. 3); and in the Western State, from \$1.08 to \$1.24 (Plate No. 4). Even the average rate of the entire United States has ranged from \$1.00 to \$1.22 (Plate No. 5). This is the more remarkable when we remember that practically all of our former schedules, with the possible exception of the Universal, have contained no provision whatsoever for such changes. We are forced to the conclusion that such changes are made by arbitrary advances or decreases, by juggling of schedules and by application of new schedules. Those of you who have had any experience in going to an assured with a new schedule of charges will agree with me that the frequent change in schedules is the cause of more trouble and ill-will on the part of the property owners and the general public than any other factor in our business. And it is expensive at the same time. The average life of schedules in the past has not been more than five years. Repeatedly we find the publication of a schedule based upon preceding experience for a period of five or ten years. The raters of the country begin on the stupendous task of applying this new schedule. At the end of three or four years, when the new schedule has been put into general use, ever-changing experience necessitates a change in rates. The schedule does not provide for any change. A flat or percentage change is unpopular and temporary at the best. We are forced to a juggling of the schedule or to the application of a new schedule

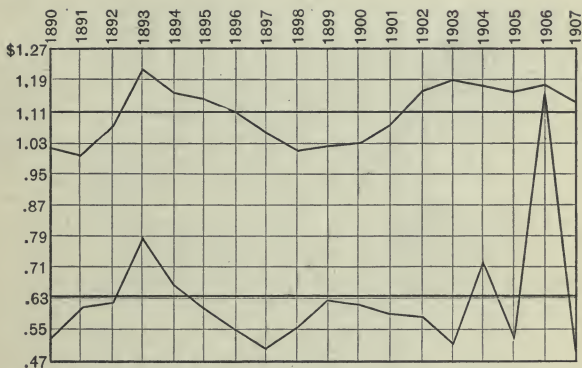


PLATE NO. 5. UNITED STATES.

Plate No. 5 shows the fluctuation of the annual burning rate or loss cost, and also of the annual rate of premium for 18 years, from 1890 to 1907, inclusive. The average burning rate or loss cost and the average rate of premium for the same period are also shown. The figures are computed for the amount of loss and the amount of premium for each \$100.00 of insurance.

- Lower crooked line—annual burning rate or loss cost.
- Lower straight line—average burning rate or loss cost.
- Upper crooked line—annual rate of premium.
- Upper straight line—average rate of premium.

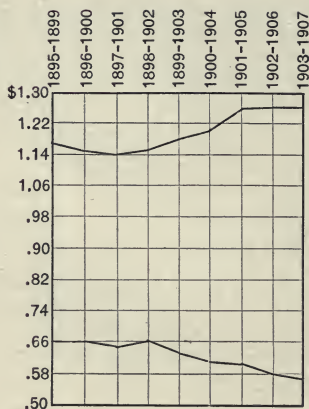


PLATE NO. 6. WESTERN STATE.
5-YEAR PERIODS.

Plate No. 6 shows the fluctuation of the average burning rate or loss cost, and also of the average rate of premium for successive five-year periods, ending with the years 1899 to 1907, inclusive. The figures are computed for the average amount of loss and the average amount of premium for each \$100.00 of insurance.

Lower line—burning rate or loss cost.

Upper line—rate of premium.

with all its attending miseries. To illustrate: Milwaukee was first placed under schedule in 1893. About three years later the old State Board schedules were replaced by what was called the Buffalo Mercantile Schedule. In 1901, five years later, the Union Mercantile Schedule was applied, and in 1906, five years later, the Analytic System was adopted. The congested district of Cincinnati has been rerated five times in the last twelve years. In a lecture before the University of Chicago, speaking of this deplorable condition, Mr. Dean said:

"You doubtless realize that as a system schedule rating consists of the establishing of relations in hazard; that it deals with a complex problem of relativity. Year after year there is an unending succession of changes in the loss and expense ratio, which together constitute the cost ratio of fire insurance; and there is an imperative necessity that rates shall be changed with some regard to the fluctuating cost of the thing sold. The present tariff system makes no provision whatever for making these changes in rates. It is simply a system of static relations. To make rate changes it is necessary to construct new basis schedules, which are merely congeries of untried suppositive relations, and then apply these schedules in making hundreds, perhaps thousands, of local tariffs. To re-rate the entire country in this way is a task of greater magnitude and expense than that of taking a national census.

"Before these new tariffs can be applied there is almost sure to be a rise or fall in the wave of annual loss, which makes the new rates either too low or too high. There is no assurance that, when they become effective, the new rates will fit existing conditions any better than the old rates. If too high, there is a revolt on the part of the public, and an immediate growth of mushroom competition which makes it necessary to begin at once the work of daubing the new tariff with competitive rates. These competitive rates, from their nature, are out of alignment with other rates, and as they multiply, soon destroy all relativity as well as all fairness in the tariffs. Again, high rates generate preferred classes, which are greedily sought by companies willing to pay high commissions, and this leads inevitably to a permanent increase in the expense ratio, which must ultimately be made good by the public. If rates are temporarily too low on some classes, other classes must make good the deficit. If too low on all classes, there is an exodus of insurance capital, until, in a panic, rates are sent skyward by a percentage advance which, unlike the rain, falls harder on the righteous than on the unrighteous, for the man who is already paying the highest rate, relatively, must submit to the largest increase under the percentage advance. The result of this is that the house of fire insurance is a house undergoing constant alterations and repairs.

The hammer and saw of the builder and the pickax and shovel of the wrecker never cease their din in the process of schedule rating and unrating. Anything approaching order, system, or any of their synonyms in this turmoil of creation and destruction is out of the question; even in the last resort of a percentage change, in the absence of any generally accepted definition of classes, it is impossible to describe what groups are to be changed without a long sequence of explanatory circulars, and circulars explanatory of these explanatory circulars."

I have spent more time than I could well afford in outlining the three general factors that any adequate schedule must recognize, because I desire to emphasize the problem which the author of the Analytic System attempted to solve when he conceived the first ideas of his system. He recognized a difference in the characteristics of each individual risk, such as construction, occupancy, protection and exposure. He recognized the difference in average experience in various states. He recognized the changing experience from year to year. In his recognition of these factors he saw the need of a schedule or rating system which would give these factors proper treatment. We now see the problem as Mr. Dean saw it. We shall follow him in his search for a solution.

THE SOLUTION OF THE PROBLEM.

In any attempt to extricate himself from a bad situation a man naturally uses all of his available resources. We have seen that differences in construction, occupancy, protection and exposure of individual risks have been well recognized in other schedules. Differences in location have been recognized, but without any thought of uniformity. The changing experience from year to year has been the chief disturber and never recognized. Thus we have only the treatment of differences in construction, occupancy, protection and exposure of individual risks as the sum total of our available resources in existing schedules. Fortunately we receive more assistance from science, and discover that several long recognized principles help us materially. These principles need no discussion here, as they are among those that are accepted and used by scientists the world over. We are more vitally concerned in their application to fire rating.

Rate is a Bundle of Relations.

The first scientific principle which we use is stated thus: All knowledge is knowledge of relations. Herbert Spencer said: "The analyses of vital action in general lead us not only to the conclusion that things in themselves cannot be known to us, but also to the conclusion that knowledge of them, were it possible, would be useless." Our knowledge of fire hazards is not a knowledge of hazards themselves, but of their relations to each other. All rates are purely comparative. What is a rate? It is a numerical expression of the relative amount of fire hazard in the risk to which it applies. All the charges that enter into the make-up of a rate are numerical expressions of the relative amounts of fire hazard in those features of the risk to which they specifically apply. Hence a rate is a bundle of relations. Mr. Dean has said:

"Fire underwriting is a business transacted upon averages. Fire hazard as a whole is a compound, not of dissociated, but of related parts, and each part is as amenable to the law of averages as the total composed of all these parts. If, under the law of averages, a thousand buildings of given construction, occupancy and protection will show a given ratio of loss to value during a given period, under the same law a thousand flues, hatchways, skylights, well-holes, wooden ceilings or other parts of the building of given construction will each contribute its unvarying quota of this ratio. Hence the several parts stand in a position of unchanging rela-

tivity, not only to the whole, but to each other. Fire hazard is by nature a network of relativity."

Our second scientific principle states that when we examine into the character of relations we find them to be of two kinds, relations of quality and relations of quantity. In the application of this principle to fire rating we learn that we are not concerned with the quality of fire hazard; that all relations of fire hazard are relations of quantity.

Co-existent and Sequential Relations.

Again, science states that all relations of quantity are either co-existent or sequential. Differences in quantity may exist at the same time or at different times. Our analysis of fire hazard teaches that the relations of fire hazard are both co-existent and sequential. Under coexistent relations we place the first two of our three general classes of hazard—i.e., those differences in hazard which exist and are recognized today among risks and among different states. Under sequential relations we place the third general class—i.e., those differences as shown by our changing experience from year to year.

Measurement Involves Use of Empirical Standard.

For the fourth time science comes to our aid and states that any measurement of quantity involves a standard. No difference in quantity can be expressed except in terms of some standard. Difference in weight can be expressed only in pounds and ounces. Differences in distance can be expressed only in feet or miles. Thus we see, if we are to measure these amounts of fire hazard, we must have a standard to measure by.

Finally science states that all standards are empirical and must be the same wherever used. Otherwise they become standards no longer. Turning to fire rating, we conclude that the standards we are to measure by must be empirical, like other standards, and must be the same wherever used. In a recent large meeting of insurance men the idea was conveyed that a uniform classification was a necessary precedent of a uniform schedule. A study of Mr. Dean's writings and of the Analytic System does not support this idea. We quote from an anonymous writer as follows:

"A widespread misconception seems to exist in the belief that a really scientific basis schedule can never be constructed until we have accumulated the data from the combined statistics of our classified experience. This misconception has been enunciated so often, so long, by authorities so high, that the truth needs to be known. The value of our classified statistics in the construction of the so-called scientific schedule are not only practically nil, but as preliminary data they are unnecessary. On the contrary, the establishment of our coexistent relations—i. e., rate estimates—on a basis

of logical and permanent relativity is a condition precedent to the treating of reliable classifications of our annual experience. In other words, logical estimates which maintain a permanent relativity are the raw material out of which, from year to year, we can, through classification, raise or lower our selling prices with intelligence. The reason for this is plain and inexorable. In constructing a tariff we are compelled to deal with parts of risks, and parts of risks are, and probably always will be, ignored in our classified statistics of annual experience. We do not keep a record of our annual experience with deficient walls, vertical openings, wooden cornices, area, flues, etc., because these things are not amenable to statistical treatment. We know that each of these parts constitutes a recognized factor in the hazard of risks as wholes, and rightly assume that each factor is as amenable to average as the risk units themselves, but we cannot, in the nature of things, observe or determine their relative contribution to the total as manifested in the risk-units. We can establish charges for them by observation, comparison, conference and a reasonable consensus. We know that a charge for a given factor that is unreasonably large will not hold against competition. We know that if unreasonably small, experience or common sense will soon right it. In fine, we establish these charges by our best collective judgment, under the well known mathematical principle known as the law of error."

Rating Schedule to be a Standard.

Our schedule for making rates is to be an empirical standard of measurement, which can be used in the making of rates at any desired level, just as a yardstick can be used in measuring a pole 100 feet high as well as one 25 feet high. In establishing our schedule as an empirical standard we are not violating any scientific precept. All standards are empirical. The standard meter of the metric system is the length of a metal bar at 32 degrees temperature kept at Paris. This bar was originally intended to be one ten-millionth of the circumference of the earth, but subsequent scientific measurements have shown that it is not. It is therefore kept as an arbitrary or empirical standard. This empirical standard which we are to use as a schedule is making fire rates must be the same wherever used. Webster defines a standard as "that which is established by *authority* as a rule or measure of quantity." That which is established by authority cannot be altered except by the same authority that established it. All measurements of distance would immediately become worthless if we measured some distances with a yardstick 36 inches long and the rest with a yardstick 30 inches long. Its unchangeableness is what makes it a standard. Our schedule, if it is to be a standard, must be the same wherever used. The same anonymous writer expresses it thus:

"If the several parts of hazard found in risk-units are bound together in an unchanging body of relativity we cannot consistently or intelligently apply tariffs which permit scores, and even hundreds, of different bodies of relativity arbitrarily established here, there and everywhere, without a single guiding principle. Admitting the absence of statistical data for the establishment of charges does not change the fact that there is an unchanging body of relations to establish and maintain, and that this involves a task worthy of our best underwriting thought."

Mr. C. H. Patton, of Cleveland, Ohio, in his talk before the 1908 meeting of the Underwriters' Association of the Northwest, said:

"By no means should a rater undertake to mollify an established schedule to meet individual grievances. The moment a single risk is thus given an advantage over others, that moment the value of the schedule is thrown away. If an error is made in framing a rate, it should without hesitancy be corrected. Under no circumstances, however, can a rater afford to discriminate by favoring insurers or agents who may be a little stronger than others in their complaints or arguments."

Although this use of the schedule as an unchangeable standard has been the working policy of the west for the last three years, the principle has not yet asserted itself completely. I was surprised the other day to hear a prominent Chicago underwriter, in speaking of the application of the Analytic System to a large western city (not Chicago), say, that he had openly advocated the re-rating of that city under the Analytic System, but with such changes in the system as the local agents wished to make. Any person that desires the Analytic System to be a permanent and adequate schedule much prefers that it be not applied at all than applied in a modified form. Such a changing of past schedules in every case has finally killed them. Let us keep the Analytic System free from this defect or we will find it as useless as the yardstick that is 36 inches long today and 30 inches long tomorrow. The Analytic System, therefore, is founded on the belief that *the analysis of fire hazard involves a measurement of those relations both coexistent and sequential, which comprise our knowledge of fire hazard, by a standard which must necessarily be empirical and which must be applied without change to all degrees of hazard now existing or possible to exist.* Let us see how these principles have been worked into a rating system.

Application of Principles.

Our rates must cover the hazards of construction, occupancy, protection and exposure, the different experience in different parts of the country and the changing experience from year to year.

Some of these factors, such as hazards of construction, occupancy, protection and exposure, are subject to analysis and can be covered by specific charges made to conform to the best underwriting judgment that can be secured. Other factors, such as the different experience in different parts of the country and the changing experience from year to year, are not subject to analysis. These must be lumped in one sum, which we call the basis rate. We thus have constructed a working definition of that mysterious something which we have called the basis rate and used for so many years without any clear understanding of what it was. Whether or not we can analyze these factors, however, we must maintain constant ratios among all of them. Our rates are bundles of constant relations. In the preface of the Analytic System we read:

"In constructing a basis schedule we necessarily select certain features of hazard as separable, and attach to each of these a charge, while to the residue, consisting of unanalyzed parts, we attach a lump charge and call it a basis rate. There is no intrinsic difference between the charge we call a basis rate and the other charges, excepting that it includes all things too obscure, indefinite or unimportant to schedule. If under the law of averages the relativity between the whole and its parts does not change, and the relativity among the several parts themselves is constant, it follows that each charge bears an unvarying relation to the basis rate, or, conversely, the basis rate a constant relation to the other charges. This being the case, it is false logic to treat the basis rate or any of the charges as a dissociated element of hazard, for every change in basis rate or charge involves a disturbance of their mutual relativity. The real question in establishing every charge is, What ratio of the total loss will this feature of hazard under the law of average probably contribute? When this ratio has been established by judgment and experience it should take its place in every schedule as a fixed ratio, bearing a constant relation to the whole and its several parts. This end may be reached by making all charges percentages of some common standard and the natural, in fact, only possible, standard for this purpose is the basis rate, because it enters into every rate, while other charges do not."

Reason for Percentage Charges.

If the consensus of underwriting judgment and experience decides that the charge for a stovepipe through a roof should be two times the charge for a brick chimney on brackets, this relation should be the same in a building with protection and a building without protection, in a building in Texas and a building in New York, in a building today and a building next year, when rates may have been put up or down to provide for changing experience. If the consensus of underwriting judgment decides that the charge

for a stovepipe through a roof should bear a certain relation to the charge for the unanalyzed hazard, namely, the basis rate, this relation should be the same in buildings with and without protection, in Texas and New York, this year and next year. Obviously, the only way to keep constant these relations of unanalyzed and analyzed hazard is to make the charges for them *percentages*, and always to use these same percentages wherever the hazards which they cover are found. The only hazard that is common to all risks is the unanalyzed hazard, and therefore the only "charge" that is found in all risks is the basis rate. For this reason the charges for analyzed hazard are made percentages of the basis rate, and we are thus enabled to maintain constant relations among individual charges and between any individual charge and the basis rate. When the difference in experience in two states calls for different estimates in those states we can then assume different basis rates, and know that the same relation existing between the two basis rates exists between the final estimates on similar risks in the two states and also between the various charges for similar defects in each risk. Also when the difference in experience from year to year calls for a change in estimate, we can change the basis rate and be sure that the same relations will continue to exist.

Percentage Charges Illustrated.

As this point is the pith of the whole matter and should be most clearly understood, I will illustrate: Assume the basis rate for all brick buildings in the year 1908, one story high and without protection, to be 80 cents. In 1913, five years later, assume the basis rate for the same class of building will be 60 cents, which is 20 cents or 25 per cent lower than the basis in 1908. Assume a stovepipe through the roof, for which the charge is 15 per cent. In 1908 the charge is 15 per cent of 80 cents, or 12 cents. In 1913 the charge will be 15 per cent of 60 cents, or 9 cents; 9 cents is 3 cents, or 25 per cent. less than 12 cents. We thus have the same relation between the two stovepipe charges that we have between the two basis rates. Also assume an occupancy charge of 45 per cent. In 1908 the charge is 45 per cent of 80 cents, or 36 cents. In 1913 the charge will be 45 per cent of 60 cents, or 27 cents; 27 cents is 9 cents, or 25 per cent. less than 36 cents. We thus have the same relation between the two occupancy charges that we have between the two basis rates. Also please observe that the charge for the assumed occupancy is three times the charge for the stovepipe in 1908, as well as in 1913; 36 cents is 3 times 12 cents; 27 cents is 3 times 9 cents. If we now assume that this defect and this occupancy are all that can be charged, we figure total charges of 15 per cent plus 45 per cent. or 60 per cent. In 1908 the final estimate on the building is 60 per cent of 80 cents, or 48 cents, plus 80 cents,

which gives \$1.28. In 1913 the final estimate will be 60 per cent of 60 cents, or 36 cents, plus 60 cents, which gives 96 cents; 96 cents is 32 cents or 25 per cent. less than \$1.28. We thus have the same relation between the two final estimates that we have between the two basis rates, or between the two occupancy charges, or between the two stovepipe charges; and furthermore, the basis rate, stovepipe charge, occupancy charge and final estimate in 1908 bear the same relation to each other that they will in 1913. If the occupancy is three times as hazardous as the stovepipe in 1908, it will be three times as hazardous in 1913, and we have it charged so. Thus by a difference in basis rates, we are able to bring about any desired difference in final estimate due to a difference in experience, without changing the relations among the various charges for hazards that can be or cannot be analyzed. Again, quoting from the preface of the Analytic System, we read:

"A tariff constructed of fixed charges and credits—in other words, a tariff in which the principle of relativity is not recognized—must, of necessity, be an unstable compound of unrelated parts. It cannot be expected to serve its purpose for any length of time, because every important change in loss ratios, which are always changing, necessitates its reconstruction or abandonment through a percentage advance or reduction which, applied as it is, to rates out of relation to each other, breeds trouble.

"A tariff built upon the cornerstone of relativity when once established becomes an organic whole—an instrumentality of logically related parts which no future exigencies of the business need ever disturb. It becomes a permanent instrument for measuring hazard, and while it is conceivable, even probable, that a new tariff so constructed may require a period of adjustment to develop consistency in all its parts, when this consistency has been finally established to conform to the best underwriting judgment, it becomes a finished structure, a permanent body of relations for the measurement of fire hazard. While it may become necessary from time to time to insert some new charge or credit to fit an innovation in hazard, aside from this necessity it is safe to assume that, once completed, it will be as unnecessary to rebuild a tariff so constructed as it is to rebuild the compass, chronometer or thermometer."

State Differences.

This fact, that the final estimates are made up of constantly related basis rates and charges, also enables us to judge of the difference in rates in various states, or at different times. If for any reason we find it necessary to use different basis rates in two states, we know how much difference exists in the rates in the two states. By difference in rates I do not mean the actual difference in average

rate. This could be obtained only by taking an average of all the rates in each state, and then would mean nothing unless we knew the differences in the schedules as used to bring about the differences in rates. By differences in rates I mean the average difference which would exist were the risks of the two states similar in construction, occupancy, public and private protection and exposure. As an illustration compare Illinois and Tennessee. These two states have been rated by the Analytic System. It was found that the use of a brick basis rate of 60 cents in Illinois and of 85 cents in Tennessee gave the desired results. This was not due to a difference in construction, occupancy, etc., in the two states, but to a difference in experience even were these hazards identical. We thus know accurately the relation existing between the rates in Illinois and Tennessee. Should any change in experience justify a change in rates, we can take intelligent action. With the application of such a system to various states and cities the companies can tell accurately where rates are low and where rates are high, and when a change in rates becomes necessary, the problem can be approached in a systematic and intelligent way. As Mr. Dean says: "The system possesses the novel and invaluable feature of recording accurately every departure from an established norm of relativity, which makes it possible to determine by comparison every inequality made necessary by the exigencies of the business and reveals with precision what is necessary to restore a proper relativity."

Schedule a Process of Evolution.

We are now in a position to realize that the construction of the schedule is a process of evolution. If our theories are right we have only to adjust our detailed charges to a point where they will embody the consensus of underwriting judgment and give the service that we require of them. In "Fire Rating as a Science" we read:

"Charges and credits are necessarily provisional assumptions. The most we can claim for them is that they are based upon united judgment and experience, through which alone approximate truth can be estimated. While even this claim will admit of debate (for they have always been the source of much controversy), there is no disputing the fact that these specific charges and credits have in them the element of abstract fairness. Applying to features common, perhaps, to all the risks of a class, or to a large proportion of the risks of many classes, they are free from the possibilities of personal favoritism. It is proper to assume that as many of these elementary factors will be too low as too high, and when a risk is unduly taxed in one charge it is reasonably sure to be insufficiently taxed in another. Under these *leveling influences* it is safe to as-

sume that each charge is automatically regulated within the limits not far from the true mean."

When we have studied the subject thus far, we see clearly defined before us these fundamental ideas: Any rating system to be permanently adequate must recognize and charge, first, for the individual features of a risk, such as construction, occupancy, protection and exposure; second, for a different experience in different localities; and third, for a changing experience from year to year. The Analytic System recognizes and charges for these three factors by the assumption that these factors are constantly related to each other and that a rating system should be regarded merely as a standard of measurement, composed of fixed charges for these relations.

With this explanation we are finished with the philosophy of the Analytic System. It is now apparent that the papers to follow will be merely an investigation of these arbitrary charges and credits, of these provisional assumptions. In the later papers we shall attempt to secure a working knowledge of the schedule. To-night, however, we have considered only the fundamental truths of theory and practice which are the foundations upon which the entire schedule rests. We have attempted to bring these out so clearly and so undistorted by details that they may secure permanent lodgment in our minds and remain there as a background throughout our future study.

Methods
OF
Operation
OF THE
Analytic System

January 26, 1909
February 23, 1909

CONSTRUCTION AND OCCUPANCY.

January 26, 1909.

Before entering upon the subject of the evening I wish to recall the points included in our first paper on the Analytic System. We dealt then with the principles and philosophy of the System. It was seen that there were three general classes of hazard to be recognized by any rating schedule which was to be permanent. The first class, those hazards inherent in or about the building itself, such as construction, occupancy, public and private protection and exposure, has been fairly adequately taken care of in schedules preceding the Analytic System. The second class, which we might call the element of place, and which had to do with the different amount of losses on the same classes of risk in different localities, has been very little recognized. The third class, which we might call the element of time, covering the changing experience from year to year, has not been recognized at all. All of our previous schedules have been inflexible. We saw that experience does differ in different states or part of states, that losses in Tennessee, for instance, are higher than losses in Illinois. We saw that experience changes from year to year as is evidenced by the changing amount of annual loss in a given class, in a given state, or in the United States as a whole.

Certain principles were pointed out which the Analytic System proposed to use in adequately measuring these various classes of hazard. Rates were described as bundles of quantitative relations to be measured by an empirical standard which could be applied without change to all classes of risks in all places and at all times, just as a yard stick could be used to measure the height of a pole 25 feet high as well as one 100 feet high. Percentage charges of an empirical basis rate were shown to be the means whereby an adequate measurement could be made of these different and varying features or elements of hazard. And a desired change in basis rate was shown to produce the desired change in final rate as called for by the different experience in various places and at various times, without altering to the slightest degree the relation existing between charges themselves which entered into the make-up of

the rate, between these charges and the final rate or between the basis and final rate.

An adequate system of measurement for the elements of place and time was thus provided and we had left only the proper adjustment of the detailed percentage charges to cover the first general class of hazard; i. e., that which had to do with the building itself, such as construction, occupancy, public and private protection and exposure. The securing of adequate statistical data to determine the proper amounts of these percentage charges, such as those for chimneys, walls, etc., was shown to be not only impractical on account of the large expense involved, but also impossible as far as some of these charges are concerned. It would take more than human genius to devise statistics that would show what part of the total hazard of a risk was due to deficient wall thickness or floor openings. Fortunately such data is not necessary since the charges can be selected by the consensus of the best underwriting judgment obtainable and the law of average makes the amount of error very small, as it is probable that charges too high would be as many as, and offset by charges too low. Competition and underwriting selection would also tend to lower charges too high and increase charges too low.

We are to investigate the methods of the Analytic System in dealing with these detailed hazards. We wish to investigate the internal structure of the schedule, to find out how these charges are made, so that when we see and recognize any feature of a building, its occupancy, its protection or its exposure as having a tendency to increase or decrease the danger from fire, we may be able to select from the schedule the percentage charge or credit which covers that feature. And then we shall see how the schedule combines these charges and credits to produce the final figure which it names as the relative estimate, in cents per \$100.00 insurance, of the amount of hazard in that building and contents.

All the hazards in or about a building group themselves under four general heads: construction, occupancy, public and private protection, and exposure. These classes include all the features of fire hazard which we care to analyze. There is no feature which is liable to start, increase or stop fire which cannot be placed under one of these heads. Moral hazard we do not attempt to analyze. We shall deal tonight with the first two classes, construction and occupancy, leaving protection and exposure for the third paper. We shall learn how to rate a building and its contents standing so entirely by itself that there is no danger of its catching fire from any other building, and also without fire protection, public or private.

CONSTRUCTION.

Remembering that the Analytic System deals only with mercantile classes, and even then does not include fireproof or sprinklered risks, we find two basis rates provided for any one locality. Brick, stone and concrete buildings take what we call for convenience, the "brick" basis rate. Frame, iron-sheathed frame, skeleton iron-clad and brick-veneered buildings take the other, or "frame" basis rate. There is no uniform relation between these two basis rates, both being empirical, and differing in the various states. You will notice that a comparatively new type of construction, namely, hollow-cement-block or artificial stone, with which also is classed tile, is not included in the above classification of buildings. The schedule provides for the use of a basis rate on this class 25 per cent. higher than the brick basis, such as 75 cents where the brick basis is 60 cents.

The various features in the construction of a building, with the exception of wall construction covered by the above difference in basis rates, are classed by the schedule under the following heads: Height, Area, Walls, Roof, Ceiling, Skylights, Openings through floors, Partitions, Chimneys, Flues and Stovepipes, Exterior attachments, Warerooms or additions, Superior construction and Objectionable conditions. We shall consider these as briefly as possible in the order named.

Height.

The one-story building is assumed as a standard and the basis rate is increased for each story over one. The amount of this increase is figured by a formula which gives greater amounts for each succeeding higher story until the height is reached where the fire protection is regarded as ineffective, when the amount of increase becomes the same for each additional story. This manner of charging for height is really a percentage charge of the basis rate of a one-story building added to that basis rate and used as a new basis rate. Thus the charge for height is distributed over all the hazards of construction and occupancy (as it should be), since the charges for these hazards are increased by reason of their being percentages of a higher figure. Absence of basement is recognized by a deduction from the basis rate. Each sub-basement is charged for by the addition to the basis rate of an amount equal to the deduction for no basement. I give example of basis rates without fire protection, as follows:

Basis Rates.

	Brick.	Frame.
One story	\$0.60	\$0.95
Two stories	.63	1.00
Three stories	.66	1.06
Four stories	.70	1.17
Five stories	.77	
Increase for each additional story.....	.07	
Decrease if no basement.....	.03	

Area.

The area of 1,000 square feet for a one-story building is assumed as a standard and any floor area over this standard is charged for by a series of percentages of the basis rate. These charges are not added to the basis rate and used as a new one as in the case of the charges for height, but are merely added to the other percentage charges for walls, roofs, occupancy, etc., to give the total percentage charge for deficiencies and occupancy. "Theoretically basis rates should be established upon the dimensions of buildings, including area as well as height, but this would cause wider extremes between the rates of small area and large area risks than public opinion or even underwriting judgment would at present sanction." There is nothing to prevent, however, the charging for area in the same manner as for height, should it be so decided later. These area charges are increased for shingle, unapproved composition or frame mansard roof, and are decreased for certain non-hazardous occupancies, and for division walls with openings or extending only to roof. I give a section of this area table as applying to all buildings:

Area Table.

Square feet of ground floor area.	One floor.	Two floors.	Three floors.	Four floors.
1,000.....	...	2%	3%	3%
2,000.....	2%	4%	5%	7%
3,000.....	3%	6%	8%	10%
4,000.....	4%	8%	11%	14%
5,000.....	5%	10%	14%	17%
6,000.....	6%	11%	16%	20%
7,000.....	7%	13%	19%	24%
8,000.....	8%	15%	22%	27%

Walls.

In the case of buildings rated under the brick tariff and for which the brick basis rate is used, proper percentage charges are made for deficiencies in thickness from an established standard for

brick, stone, concrete, hollow-cement block or tile walls. The charge is 1 per cent. for each inch of average deficiency. Standard thicknesses are given for party walls dividing two buildings, for independent or exterior walls, supporting and non-supporting walls, walls ledged and not ledged, walls braced with pilasters and walls of pier construction. A difference in standard is also made according to the character of the occupancy above the grade floor. Certain occupancies, such as banks, barber shops and offices, are classed as "light" occupancies and require lighter walls than other occupancies which are classed as "ordinary."

Where a building is near enough to be damaged by fire from another building, the walls are required to extend above the roof a standard distance, to be of proper thickness and coped. Charges are provided for deficiencies in this respect.

In the same class of buildings, namely, where a brick basis rate is used, the presence of frame, iron-sheathed frame, brick-veneered, iron and glass, hollow-cement-block or tile walls in the front or rear is covered by a proper percentage charge. This charge is doubled if a wall of this character is a side wall. A charge is also made for plate glass windows of unusually large dimensions, and for bay windows.

In buildings rated from the frame basis rate, such as skeleton iron-clad and brick-veneered buildings, the frame wall is accepted as a standard and percentage credits are made for better construction. No credit is given for iron-sheathed frame walls on an unexposed building.

Roof.

In the case of brick buildings a metal, tile, slate or approved composition roof is accepted as standard and a charge of 20 per cent. is made for a shingle or unapproved composition roof. Charge is also made for frame mansard roof. With frame buildings a shingle or unapproved composition roof is accepted as standard and a credit of 10 per cent. is made for metal, tile, slate or approved composition.

Ceilings.

In brick buildings a charge of 2 per cent. is made for wooden ceilings, each story, and of 5 per cent. for strawboard, paper or canvas ceilings, each story. These charges are increased one-half if walls as well as ceilings are so sheathed.

Skylights.

In brick buildings, charges are made for openings through the roof not covered with standard skylights. Standard skylights are described. The charge is 3 per cent. for the largest opening of

40 square feet or less, increased 1 per cent. for each additional 40 square feet or greater part, and 2 per cent. for each additional skylight. The 3 per cent. charge is raised to 5 per cent. in the case of 'photographers' skylights not standard.

Floorway Openings.

In brick buildings charges are made for openings through floors. No charge is made where the opening is protected with an automatic closing or trap. Credits are given when the openings through a floor of superior construction are protected in a superior manner specified. All of the openings through a floorway are, for convenience, referred to as its *retinue*. Charges for the various kinds of floorways and retinues are made by the following table:

Floorway Retinue Table.

EACH FLOORWAY	D	C	B	A
With retinue <i>d</i>	—4%	—3%	—1%	0
With retinue <i>c</i>	—2%	—2%	—1%	0
With retinue <i>b</i>	—1%	—1%	—1%	0
With retinue <i>a</i>	—0%	—0%	—0%	0
With retinue below <i>a</i>	+5%	+5%	+5%	+5%
For each "below <i>a</i> " opening over one up to double the charge...	+1%	+1%	+1%	+1%

If any floorway is finished with concealed spaces, the credits in above table are reduced one point.

In this table all floorways are divided into four grades which may be roughly defined as follows:

- A. Matched wooden flooring laid on joists of ordinary dimensions with lath and plaster, wood or metal ceiling beneath.
- B. Same as A. Two layers of matched flooring.
- C. Floorways not less than the following:
 1. Floors, three inches thick if adequate for their load.
 2. Floorway supports, consisting of posts, beams and girders, 6x6 inches, if adequate for their load. If cast-iron or steel, to be protected by 2 inches of terra-cotta, concrete or its equivalent. No strap-iron stirrups to be used.
 3. Finish without concealed spaces.
 4. Partitions, non-combustible.
- D. Floorways not less than the following:
 1. Floors three-inch splined plank covered with one-inch dressed flooring.
 2. Floorway supports, consisting of posts, beams and girders, 8x8 inches if adequate for their load. If cast-iron or

steel, to be protected by 2 inches of terra-cotta, concrete or its equivalent. No strap iron stirrups to be used. Beams to rest on wall ledges, or, if entering walls, to be self-releasing. Posts or pillars to be superimposed throughout all stories with ends connected by approved cast-iron caps (self-releasing as regards floor beams) with cast-iron base plates and pintles.

3. Finish without concealed spaces.

4. Partitions non-combustible.

All floorway retinues are divided into four grades, which may be roughly defined as follows:

a. Opening with standard trap or enclosure of matched flooring, with enclosure door, if any, of same material and self-closing.

b. Opening with standard trap or enclosure of matched flooring, two thicknesses, with enclosure door, if any, of same material and self-closing.

c. Opening with standard trap covered with tin as for standard fire doors; or with enclosure of plaster or cement on both sides of metal lath, supported by iron frame, or tile or terra cotta with door standard metal or metal-clad and self-closing.

d. Opening in brick shaft, with standard fire doors.

The sign (+) stands for a charge, and the sign (—) for a credit. With this explanation we are able to make the proper charge for any possible combination of floorway and retinue construction.

As this method of treatment of floorway openings is somewhat new, an illustration of its manner of application will be in order. Assume a three-story brick building with a basement. The floorways are constructed of matched wooden flooring and therefore grade as A. An elevator extends from the basement to the second story. The elevator opening through the first floorway (i. e., floor between the basement and first story) is protected by an automatic elevator trap which grades as *a*. The elevator opening through the second floorway is unprotected and therefore grades as "below *a*". A stairway extends from the basement to the third story with all openings unprotected and therefore grading as "below *a*". Each floorway and its openings are charged for separately from the other floorways and their openings. The retinue of each floorway is graded by the opening of poorest protection in that floorway. The charge for the first floorway retinue, therefore, will be for a retinue grading as "below *a*" combined with a floorway grading as A, which by reference to the table, gives 5 per cent. The charge for the second floorway retinue will be for the same gradings of retinue and

floorway, increased 1 per cent. for one additional opening grading as "below a". The charge for the third floorway will be for the same combination with only one opening, i. e., 5 per cent. Our total retinue charge for this supposed building is therefore 5 per cent.+6 per cent.+5 per cent., or 16 per cent.

Two reasons exist for this method of treatment of floorway retinues. Please notice that no more credit is given for a retinue of a grade superior to that of its floorway than is given for a retinue of the same grade as the floorway. No more credit is given for stairway in a brick shaft with fire doors on the openings than for an enclosure of matched pine with a self-closing door of the same material, provided the floorways are merely matched flooring on ordinary joists. In other words, there is no need of protection for opening stronger than the floorway itself. A chain is no stronger than its weakest link. Also please notice that the table provides that the largest charge shall remain until all of the openings in a given floorways are protected. The credit for protecting all openings except one in a floorway is so small as to be scarcely worth the expense. This offers the large credit for the protection of the last opening, on the theory that the danger of smoke and fire passing from one story to another is not appreciably diminished until all openings are protected.

Our treatment of retinue charges thus far has dealt only with the charges for openings through floors above "ordinary" occupancies where the building is of "ordinary" occupancy construction. As explained under wall charges, such occupancies as banks, barber shops and offices are classed as "light" and other occupancies such as wholesale groceries, meat markets and department stores are classed as "ordinary." With "ordinary" occupancies is generally found what the schedule classes as "ordinary" construction, i. e., where the stairways, elevators, etc., lead directly from the rooms of one story to the rooms of the other stories. With "light" occupancies is generally found what the schedule classes as "hallway" construction, i. e., where the stairways, elevators, etc., are in separate hallways. In the case of hallway construction, the schedule provides that the floorway openings should be charged for as in ordinary construction, with the added provision that the grade of the retinue may be determined by the construction of the partitions separating the hallways from the main building, as well as by the traps or enclosures for openings. Where the partitions are thus classed as retinues, the following standards are provided:

"below a." Ordinary wood lath and plaster with wooden doors.

a. Plaster or cement on metal lathing with self-closing doors of wood two inches thick.

- b. Plaster or cement on metal lath and studding, or tile or brick with self-closing standard metal or metal-clad doors.

The schedule also provides that when a story contains exclusively light occupancies its retinue, if consisting of hallway partitions as above, may be counted as one grade higher, i. e., if "below *a*" as *a*, if *a* as *b*, etc. As this is the usual condition in buildings of hallway construction, such as office buildings, the retinue will grade as *a*, and therefore no charges are made for elevator and stairway openings in hallways in such buildings.

Partitions.

In brick buildings standard partitions between ground floor or basement occupancies are described as brick, tile or plaster on both sides of expanded metal on iron supports, or other equally fire-resisting materials and small charges are made for departures from this standard, as for wooden partitions, etc.

Chimneys.

In both brick and frame buildings chimneys and flues should be of brick, built from the ground, or may be ledged in walls of approved construction. Departures from this standard such as chimneys on brackets or stovepipes through roof or partitions are properly charged for. Charges are increased one-fifth for each flue or stovepipe so deficient up to double the charge.

Exterior Attachments.

The standard brick building is assumed as free from all exterior attachments such as wood cornices, awnings, roof houses, etc., and small charges are made for each of these when found on such buildings.

Warerooms.

In the case of brick buildings the presence of a frame, iron-sheathed frame, skeleton iron-clad or brick-veneered addition is met by a percentage charge determined by the percentage relation which the floor area of wareroom bears to the combined floor area of main building and wareroom. Our time is too short to enter into an explanation of these charges. You will find a detailed treatment of this subject in the back of the schedule.

Superior Construction.

When a brick building is found of superior construction to that of the standard assumed, i. e., that of the average mercantile building, it is necessary to give some recognition in rate for such superiority. Since superior construction decreases all of the hazards

of or in a building, such recognition should decrease all charges for structural features and occupancy, and is therefore made a percentage credit of the rate resulting from the addition of all charges for such features. The percentage credits are given herewith:

- a. If all floorways and their supports class as D, with retinues *d*.....Deduct 20%
- b. If all floorways and their supports class as D, with retinues inferior to *d*, or if all floorways and their supports class as C with retinues of all-grades...Deduct 10%
- c. When a building with a basement or over one story high has a roof of ordinary rafter and roof board construction, reduce credit *a* five points or *b* three points.
- d. If roof boards less than 3-inch splined plank and (or) roof timbers are less than 6x6 inches, reduce credit *a* two points (not cumulative with *c*).
- e. If posts, beams or girders less than 6x6 inches, or of cast iron or steel not properly protected, or if strap iron stirrups, reduce credit *b* four points.
- f. If combustible partitions, reduce credit *a* or *b* three points.
- g. When ground floor of a building without basement is non-combustible Deduct 5%

Objectionable Conditions.

We have now discussed all of the regular features of construction which the schedule recognizes by percentage charges or credits. In the case of unusual conditions of building, such as cracked walls, broken plaster, etc., small flat charges are made, called "after-charges," the size of which must necessarily be left to the judgment of the rater, but which the schedule provides may run from 5 cents to \$1.00. These charges are "added to building and contents after final rate, including exposures, has been figured in order that change may not necessitate a re-rating."

By the notations made under each of the above headings, please notice that the only structural charges and credits which apply to frame buildings are those for height, area, walls, roof, chimneys and objectionable conditions. No charge is made for other structural features such as skylights, partitions, etc., because their presence is not considered as increasing the hazard of the building to a sufficient extent to warrant analysis. The slight increase in hazard, if any, is thrown into the basis rate with other unanalyzed hazards.

With the exception of the occupancy charge we are now in a position to figure the rate on a building that is unexposed and unprotected. Before investigating the occupancy charge, the total of

which is a percentage like any of the charges for structural features, I propose to rate a typical building, assuming an occupancy charge, in order that we may see how far we have proceeded with our study.

Example, Brick Building.

Basis rate, five story and basement, 60 table.....	\$0.77
Area, 5,000 square feet; six floors (including basement) 22%	
Two walls, side, deficient 4 inches each, at 4%.....	8%
Two parapets, deficient 12 inches each in height, at 2%. 4%	
Five floorways of grade B, with two openings each floorway, grading as "below a"; $5\%+1\%=6\%\times 5=$	30%
Occupancy (assumed)	109%
Charges added and extended.....	173% 1.33
Occupied building rate.....	\$2.10

Example, Brick-Veneered Building.

Basis rate, two stories, 95 table.....	\$1.00
Area, 3,000 square feet.....	6%
Chimney on brackets.....	8%
Occupancy (assumed)	144%
Total charges	158%
Walls, brick-veneered with metal roof, credit.....	15%
Net charge extended.....	143% 1.43
Occupied building rate.....	\$2.43

OCCUPANCY.

We now approach that part of our subject which with exposure, Mr. Dean has said, constitutes the real substance of fire hazard. "In the matter of occupancy there is no evidence that classification has played more than a rudimentary part in any existing tariff." The vast majority of occupancy charges in most rating schedules are merely lump sums supposed to cover all hazards found with the occupancies to which they apply. We look in vain for adequate treatment of the numerous causes or effects of fire, smoke and water found in occupancy, such as labor, heat devices, traffic hazard, etc. The problem is a difficult one, and needed all of that ability to assort and classify, which stands out as the most characteristic of Mr. Dean's genius.

The hazard of occupancy in general is recognized in three ways; first, as a cause of fire, as originating combustion; second, as a medium for fire, as aiding combustion when once started, and third, as an effect of fire, smoke or water. The hazard of occupancy as a cause of fire will be discussed under a classification of cause; the hazard as a medium for fire depends upon the combustibility of the contents and will be discussed under a classification of combustibility; and the hazard as an effect of fire depends upon the damageability of the contents and will be discussed under a classification of damageability. As the hazards of causes vary with the combustibility of the material or stock with which they are found, we naturally seek first the classification of combustibility.

Classification of Combustibility.

The grade of combustibility of merchandise is sometimes influenced by packages, by quantity, or by arrangement more than by the merchandise itself. Sometimes "the materials used for packing or the debris resulting from unpacking constitute the real hazard of an occupancy." Some stocks are spread out for display. Other stocks are stored away in large quantities piled to secure greatest economy of space. These must be taken into account eventually. Ignoring them for the moment, however, the Schedule offers us five grades of combustibility based upon the quality of the merchandise itself. For convenience these grades are designated as (C1), (C2), etc., where C stands for combustibility.

(C1) Low. "Merchandise which does not in itself constitute a fuel for the spread of combustion. Examples: hardware, leather, hides (green or dry), rubber goods, wool, woolen goods, canned goods, etc." Charge 5 per cent.

(C2) Middling. "Merchandise which burns moderately in itself but may contain small quantities of a higher grade of combustibility, either through policy permits or common usage. Examples: retail groceries (with matches, coal oil, etc.), dry goods or country store stocks (with celluloid goods, cotton batting, millinery, straw goods, etc.)." Charge 10 per cent.

(C3) High. "Merchandise which burns freely, constituting an active fuel. Examples: straw goods, millinery, hay, hemp, etc." Charge 20 per cent.

(C4) Quasi-incendiary. "Merchandise that burns with great intensity and is difficult to extinguish, but is not liable to sponta-

neous combustion or to ignition except through actual contact with fire. Examples: matches, celluloid goods, saltpeter, etc.; also combustible substances finely divided, such as shavings in hand woodworkers, carpenters or cooper shops, etc., but not so finely divided as to constitute explosive dusts." Charge 80 per cent.

(C5) Incendiary. "Including substances that burn with an intensity equal to or greater than (C4), and in addition give off inflammable or explosive vapors at ordinary weather temperatures, or that spontaneously ignite through exposure to air or moisture, also substances which as a result of industrial processes produce large quantities of dusts, lint and other finely divided vegetable debris that is subject to flash fires or explosions, if not safely disposed of through an approved blower system. Examples: crude petroleum and all its lighter products, ethers, carbide, turpentine and the debris of planing mills, cotton gins, flouring mills, etc. Charge 320 per cent.

In addition to these five grades of combustibility based upon the quality of merchandise itself, two intermediate grades are established by the conditions of quality or arrangement, which, we have said, were ignored in the classification of the five grades, as follows:

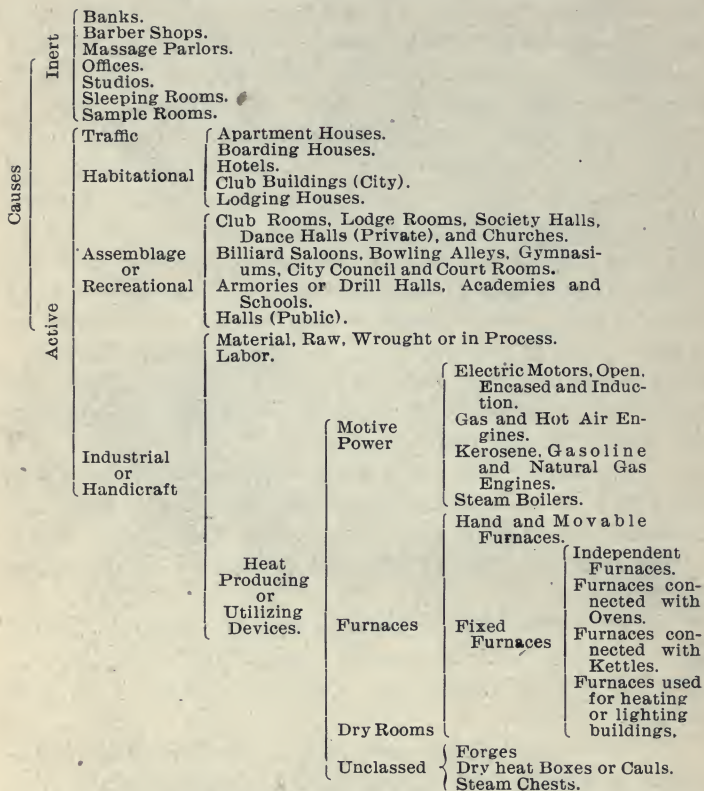
(C3½). "This grade is not susceptible of definition by quality, but is used principally for quantity, being available for large open stocks of (C3) or for moderate quantities of (C4)." Charge 40 per cent.

(C4½). "Like (C3½), this grade is not susceptible of close qualitative definition, but it is available for minor industrial risks or where grade (C5) is reduced by an approved blower system, also for animal substances, such as wool, felt, etc., which give off combustible dusts of a lesser hazard than the dusts from fibrous vegetable substances, such as wood, cotton, etc. The class is also used quantitatively for large storage risks of grade (C3) or (C4)." Charge 160 per cent.

Classification of Causes.

Leaving for the moment the classification of combustibility of stocks or material, we pass to the more complicated classification of causes of fires as found in occupancy. This classification of causes presents such a formidable array of material that I have prepared same in the form of a diagram in hopes thus to bring the subject before you in the clearest and most concise manner. The diagram follows:

Diagram for Classification of Causes.



Following the diagram, please note that all causes of fires pertaining to occupancy are divided into inert and active. By the list that is given for inert, it is evident that such occupancies are almost without hazard, as far as cause is concerned. The slight physical hazard, if any, is considered as offset by the protection afforded by human presence, and no charge is made. Any special hazard that may exist in these occupancies, such as a hot-water heater for baths in a barber shop, is covered by specific charge.

Active occupancies are divided, as shown, into the hazards of traffic and the causative hazards in habitational, assemblage or recreational and industrial occupancies. The traffic hazard is that "caused by employes and customers in the regular transaction of business, connected with mercantile shops, retail or wholesale." As the hazard increases with the combustibility of the stock, the charge

ranges from 3 per cent. for a (C1) stock up to 80 per cent. for a (C5) stock. Habitational occupancies which are self-explanatory are covered by the various charges provided for the different occupancies listed under this class. Assemblage or recreational occupancies consist of "rooms or halls used for assemblies or resorts, where people gather together for some common purpose, aside from commercial or industrial activities." Various charges are provided for this class.

Industrial occupancies consist "of all industrial activities found in mercantile buildings, either connected with stocks of merchandise or independent." The hazards of industrial occupancies are divided, as shown, into those caused by materials, raw, wrought or process, by labor and by heat-producing or utilizing devices. The hazard of materials consists in their presence as a medium of combustion and hence is charged for according to the preceding classification of combustibility. Labor covers "the hazard of manipulation of materials in the making, handling, packing, shipping, etc." The average number of hands engaged is used as a basis for the charge for labor, the amount of which depends, of course, upon the combustibility of materials handled. A minimum charge for five hands or under is given, together with charges for numbers over five. I give a section of the table of labor charges:

Labor Table.

	C 1.	C 2.	C 3.	C 3½.	C 4.	C 4½.	C 5.
<i>Minimum Charge.</i>							
5 hands or under...	5%	10%	15%	25%	40%	60%	80%
<i>Additional Labor.</i>							
5 additional hands..	4%	5%	6%	7%	9%	11%	13%
10 " "	8%	10%	12%	14%	18%	22%	26%
20 " "	12%	15%	18%	21%	27%	33%	39%
30 " "	16%	20%	24%	28%	36%	44%	52%
40 " "	20%	25%	30%	35%	45%	55%	65%

Heat producing or utilizing devices are of such variety as to necessitate an extensive classification of their own. The schedule considers them under the heads of motive power, furnaces, dry rooms and unclassified. Charges for motive power are made according to the nature of the power device and the combustibility of the stock or material by a table of motive power charges, a section of which is shown herewith:

Power Table.

Class.	Electric Motor.		Gas, Hot Air, Kerosene or Natural Gas Engine.	Standard Gasoline Engine.	Steam Power.			
	Pattern.				Portable B & E.		Stationary B & E.	
	Encased or Induction.	Not Encased.			Brick Stack.	Metal Stack.	Brick Stack.	Metal Stack.
C 1	0%	0%	5%	10%	15%	30%	40%	60%
C 2	0%	10%	10%	15%	25%	40%	50%	70%
C 3	0%	15%	15%	25%	35%	50%	60%	80%
C 3½	0%	20%	20%	40%	45%	60%	70%	90%

The charges in this table cover the hazard of one device of the kind and are increased one-fifth up to double the charge for additional devices. Where more than one kind of power device is found in one occupancy, the full charge is made for the most hazardous, plus one-fifth of the charge of the others up to double the charge of the most hazardous. For instance, if we have two open motors in a C3 stock our charge will be 15%+ (1/5 of 15%=) 3%=18%; or if we have one stationary boiler, brick stack, and two electric motors in the same grade of stock (C3), our charge will be 60%+(2/5 of 15%=) 6%=66%.

The above power charges cover the hazard of the device in the open. When located in separate room or power house reductions from the above charges are allowed. The additions provided by the schedule for more than one metal stack, or for floor pierced by metal stack, or for non-standard arrangement of gasoline engine are self-explanatory.

Furnaces are classed as hand or movable furnaces, and fixed furnaces. Hand or movable furnaces include fire, glue and soldering pots, crucibles, cupels, ironing furnaces and other movable heat devices. Fixed furnaces include furnaces which stand by themselves for producing heat to be used in dry rooms, or for heating buildings, including cooking stoves, or ranges and laundry furnaces; also furnaces connected with ovens, such as bake-ovens, china firing ovens, annealing ovens, japanning ovens, coffee-roasting ovens, etc., also furnaces "connected with open kettles or vats for heating substances liable to combustion, as in candy making, meat rendering, cruller making in bakeries, etc." Charges for these furnaces differ with the kind of furnace and the combustibility of the stock or material, and are made by a table, a section of which is shown herewith:

Furnace Table.

Class.	Hand or Mov-able.	Fixed or Stationary.				
		Steam Kettles with Combustible Contents.	Furnaces, Independent or with Kettles with Non-combustible Contents.	Connected with		Each Additional Kettle with same Furnace.
				Ovens.	Kettles with Combustible Contents.	
C 1	5%	0%	5%	10%	15%	3%
C 2	7%	5%	10%	20%	25%	5%
C 3	10%	7%	15%	25%	35%	7%
C 3½	12%	12%	25%	35%	55%	11%
C 4	16%	20%	40%	50%	85%	17%
C 4½	20%	25%	50%	60%	105%	21%
C 5	25%	30%	60%	70%	125%	25%

Above charges are based upon the use of coal or charcoal for fuel, and are reduced one-half if artificial gas or electricity is used. When more than one furnace the charge is increased one-fifth for each furnace over one up to double the charge. In the case of fixed furnaces the charges are doubled if not on approved non-combustible floor (except when electricity is used for fuel). Charges are increased for metal stacks from furnace, and credits are given for location in separate rooms or additions in the same manner as for power devices. As the heating of buildings is almost universal, the schedule follows the precedent established by other tariffs of accepting the common condition as the standard, and regards the hazard of furnaces and steam boilers (not over 15 pounds pressure) used exclusively for heating the building as included in the basis rate. No charge is made for such furnaces and boilers under the above table, and a credit is given to a building without heat or heated from outside source.

Dry rooms comprise the next class of heat utilizing devices. Three classes of dry rooms are recognized, i. e., non-combustible, metal and asbestos lined and frame. Three grades of heat are recognized, i. e., under 125 degrees, 125 degrees to 200 degrees, and 200 degrees to 300 degrees. Charge is made according to the class and temperature of dry room, and the combustibility of the contents. I give the table of charges for non-combustible dry rooms.

Dry Room Table.

Maximum Temperature.	Combustibility				
	C1	C2	C3	C3½	C4 and over
Under 125°	5%	10%	15%	20%	25%
125 to 200°	10%	15%	20%	25%	30%
200 to 300°	15%	20%	30%	40%	50%

The device furnishing heat for the dry room is charged for

separately as an independent furnace unless located inside the dry room, when the charges given above are doubled.

Forges, dry heat boxes or cauls and steam chests are regarded as the unclassified heat devices. Forges are regarded as fixed or movable and charges are based upon combustibility of stock or material, and kind of floor. Dry heat boxes are treated in much the same manner as dry rooms, except that the charges are smaller. No charge is made for a wet-steam chest safely arranged.

Classification of Damageability.

The treatment of medium and cause being completed, we have left only damageability or effect, before assembling our various charges into the lump occupancy charge. In case of fire, goods are damaged by fire, heat, smoke, water, change of temperature, breakage, soilure, theft, etc. For convenience fire and heat are called direct effects and the others resultant. Damageability is classed in four grades designated for convenience as (D1), (D2), etc., where D stands for damageability.

(D1) Low. "Merchandise that is largely immune to resultant effects, being materially affected by the direct effects of fire. Examples: Heavy hardware, leather or rubber stocks, hides, wool and woolen goods, canned goods, etc."

(D2) Middling. "Merchandise that is but moderately affected by direct and resultant effects. Examples: Retail groceries, dry goods, boots and shoes, hats and caps, etc."

(D3) High. "Merchandise that is easily damageable by direct or resultant effects. Examples: Musical merchandise, books and stationery, paper, butter, eggs and cheese stocks, fruits, etc."

(D4) Extra. "Merchandise that is liable to heavy damage from slight causes either direct or resultant ('Total Loss Risks'). Examples: Millinery, artificial flowers, florists' stocks, contents of green or hothouses, stocks of birds and rare animals, high-grade art stocks and paintings."

The grades of $D1\frac{1}{2}$, $D2\frac{1}{2}$ and $D3\frac{1}{2}$ have been established half way between the regular grades, to include certain classes which differ from the regular grades by amounts too small to warrant placing them in the next higher or lower grades.

Much has been written in discussion of the proper manner of figuring rates on contents. What relations shall the rate on contents bear to that on building? Shall the difference between contents rate and building rate—let us call this difference the contents differential—decrease as the building rate becomes higher? If so, shall this decrease be absolute or relative? Shall fire department protection increase the differential? Shall the differential vary with the floor or story upon which the stock is found? As the

province of this paper is to explain and not discuss, we must be content with an investigation of the treatment of the Analytic System on these points.

Mr. Dean attempted to solve these questions in his treatment of damageability. The damageability of a stock has no effect upon the containing building. Damageability should be regarded merely as relative and the charge for damageability should measure the difference between the damageability of the building and contents. Looking at it in this way, the charge obviously should be an amount (not percentage) added to the final building rate. This amount should be more where the building is brick than where it is frame, on account of the brick being less damageable than the frame—due chiefly to salvage in brick walls—and hence further removed from the hazard of the contents. This amount should increase, not only with the damageability of the contents but also with the efficiency of fire protection due to the increased difference in the amounts of loss on buildings and contents under better grades of protection. This difference has even reached a point in the larger cities where experience shows losses on contents three or four times as much as on buildings. The schedule provides, therefore, proper amounts as expressing this difference in hazard for each of the four grades of damageability for contents located on the ground floor. A regular scale of increase is applied for location in basement or above ground floor and also for the higher grades of protection. One table based upon a charge of 10 cents for (D1), 20 cents for (D2), 40 cents for (D3), and 60 cents for (D4) contents on the ground floor of a building without fire protection was thus computed and called the “100” contents table. The grades $D1\frac{1}{2}$, $D2\frac{1}{2}$ and $D3\frac{1}{2}$ were figured half way between the regular grades. Lower tables were also figured from the “100” table by taking a uniform percentage of its charges. Thus the “80” table was 80 per cent. of the “100” table, “70” table 70 per cent. of the “100” table, etc. As an illustration, I give you contents table No. 70 applying only in a town without fire protection. The increase for higher grades of protection will be taken up in the paper dealing with Protection:

Brick Contents Table.

Location of Contents.	D1.	$D1\frac{1}{2}$.	D2.	$D2\frac{1}{2}$.	D3.	$D3\frac{1}{2}$.	D4.
Basement	\$0.15	\$0.19	\$0.23	\$0.31	\$0.38	\$0.46	\$0.54
Ground floor.....	.07	.11	.14	.21	.28	.35	.42
Second floor.....	.15	.19	.23	.31	.38	.46	.54
Third floor and over....	.20	.25	.29	.37	.45	.53	.61

With reference to frame buildings, the schedule provides that contents grading as (D3) and ($D3\frac{1}{2}$) shall take a 10c contents differential and (D4) a 14c differential in towns without protection.

Contents grading as (D1), (D1½), (D2) and (D2½) take same rate as building.

We have thus hurriedly summarized this classification of cause, medium and effect, which analyzes occupancy so much more closely than any other schedule. We have not sought to confuse our subject by this treatment of classification, but rather have felt that familiarity with its methods was necessary to a thorough understanding of the occupancy lists as they appear in the schedule itself. Please remember that the average rater in his daily use of the schedule seldom refers to this extensive classification. It was used by the author of the schedule and those associated with him in their compilation of the occupancy list. The rater, however, merely refers to these lists and uses such charges as they supply.

All of the notations covering occupancy charges are placed in an alphabetical list of occupancies, wherein the charges appear in three columns and opposite the name of the occupancy to which they apply. A section of this occupancy list appears as follows:

Brick Occupancy List.			1	2	3
Carpet Cleaning Establishments (not over 1 gallon of gasoline in approved safety can)			25%	40%	D2
1. Additional labor (C3½).					
2. Power (C3½).					
3. If gasoline not in approved safety can..			10%		
4. If over 1 gallon of gasoline, see Cleaning Establishments (Naphtha, etc.).					
Carpet Linings and Mattings, paper or straw...			10%	20%	D3
Carpet and Rugs, Stocks of.			3%	5%	D1½
1. Labor (sewing) (C1).					
2. Power (C1).					
Carpet Weaving.....			10%	10%	D2
1. Additional labor (C2).					
2. Power (C2).					

Column 2 contains the combustibility charge established by the classification of combustibility given above. Column 1 is the column of "Causes" and contains, in the case of industrial occupancies, the minimum charge for labor established by the labor table; in the case of mercantile occupancies, the charge for traffic, and in the case of habitational, assemblage or recreational occupancies, the charge established in the classification of causes for these occupancies. Charges for other causative hazards are made by reference to the proper tables in the classification under causes, and the grade of combustibility for which the charge is to be made is provided. As an illustration the words "Additional labor (C3½)" under Carpet Cleaning Establishments mean that a charge should

be made from the labor table for the average number of hands over 5 engaged in the work on a basis of (C3½) combustibility. The words "Power (C3½)" mean that any power device should be charged for according to the power table on a basis of (C3½) combustibility. Column 3 is the column of effect. It classifies the damageability of the contents and means that the proper contents differential should be selected from the contents table, according to the floor in which the stock is located, and added to the final building rate to establish the contents rate.

In the case of a building occupied by only one tenant, called a "single occupancy" risk, the sum of the charges in columns 1 and 2 and those for special features, additional labor, power, etc., gives the total occupancy charge to be added to the deficiency charges to give the final rate on building. In the case of a building occupied by more than one tenant, called a "multiple occupancy" risk, the same method is followed, except that only highest charge in column 2 is used. This is based on the theory that "combustibility as a form of latent energy is governed by the physical law that all transfers of energy of any given kind are from bodies having more to those having less. Under this law the highest charge only in column 2 should enter into the rate, regardless of the number of occupancies in the containing building." Illustration, single occupancy: Assume building containing stock of carpet linings and mattings. The charge (see occupancy list above) is 10 per cent.+20 per cent.=30 per cent. Illustration, multiple occupancy: Assume one-story building containing two tenants, one carrying a stock of carpet linings and mattings as above, and the other a stock of carpets and rugs without carpet sewing. The charge (see occupancy list above) is the sum of both charges in column 1 and the higher charge in column 2, i. e., 10 per cent.+3 per cent.+20 per cent.=33 per cent.

The above classification of combustibility has not been extended as yet to the figuring of the occupancy charge in frame buildings. This was due to the precedent established by previous tariffs, which made it necessary that the rate on a frame building of more than one occupancy should agree closely with the rate on a row of frame buildings of the same occupancy. As the extension of the above classification to this class would not produce this result, a separate treatment was given the occupancy of frame buildings. "The exigencies of the case have been met by making a total occupancy charge that will produce a rate for each specific class, which substantially agrees with its average rate as found in existing tariffs. This total charge is then apportioned to columns 1 and 2 by placing in the former enough to approximate the radiated exposure of the risk under the 40 per cent. exposure standard and

placing the balance of the charge in column 2, in lieu of the combustibility charge found in column 2 in brick tariff. In all the minor occupancies where the quantity of combustibles is negligible, as well as in all stocks that would ordinarily class as (C1) and (C2), this leaves no remainder to appear in column 2." With this exception, however, the occupancy list for frame buildings appears very much the same as for brick buildings and is used in exactly the same way. A section of frame occupancy list appears as follows:

Frame Occupancy List.		1	2	3
Carpet Cleaning Establishments (not over 1 gal- lon of gasoline in approved safety can)		70%	30%	D2
1. Additional labor (C3½).				
2. Power (C3½).				
3. If gasoline not in approved safety can...	10%			
4. If over 1 gallon of gasoline see Cleaning Establishments (Naphtha, etc.).				
Carpet Linings and Mattings, Paper or Straw..	60%	20%		D3
Carpet and Rugs, Stocks of.	30%			D1½
1. Additional labor (sewing) (C1).				
2. Power (C1).				
Carpet Weaving.....	50%			D2
1. Additional labor (C2).				
2. Power (C2).				

You will remember at the conclusion of our treatment of construction that an illustration was given of the method of rating brick and brick-veneered buildings in which an occupancy charge of 109 per cent. for the brick and of 144 per cent. for the brick-veneered was assumed. We are now in a position to illustrate the method of figuring these two occupancy charges and also of obtaining the rate on contents.

Occupancy: Carpet Cleaning Establishment.		Brick Building.	Brick-Veneered Building.
Regular occupancy charge (see occupancy lists) 25%+40%=.....	65%	70%+30%=100%	
Additional labor, 10 hands (C3½), (see labor table)	14%		14%
Electric motor, open (C3½) (see power table)	20%		20%
1 gallon gasoline not in approved safety can	10%		10%
Total occupancy charge.....: 109%			144%
As illustrated in the example under construction these charges			

are added to other deficiency charges in figuring the rate on building. This results in a rate of \$2.10 on the brick and \$2.43 on the brick-veneered. As the contents of the brick-veneered building without fire protection (D2) take the same rate as building, \$2.43 will also be the rate on contents. The rate on the contents of the brick building is obtained by adding to the building rate the average contents differential for a D2 contents (see occupancy list) located in the basement and on the first to fifth floors inclusive, as follows (see contents table): $\$0.23 + .14 + .23 + .29 + .29 + .29 = 1.47 \div 6 = .24$. This added to \$2.10 gives \$2.34.

We have seen how the Analytic System rates an unexposed and unprotected building and contents. We have become familiar with its methods of operation governing construction and occupancy. There still remains for consideration its treatment of protection and exposure. In the third paper we shall begin where we stop tonight with the rate on the unexposed and unprotected building and contents, and carry it through until we obtain the rate with fire protection both public and private and also with exposures from other buildings.

PROTECTION AND EXPOSURE.

February 23, 1909.

In our study of the Analytic System as a system for measurement of fire hazard we have already seen that it recognizes the factors of place and time—that is, the different experience in different localities and the changing experience from year to year—by the proper selection or changing of basis rates without disturbing the internal or external relations of the rates themselves. We have said that it recognizes all the influences in or about a building under the four items of Construction, Occupancy, Protection and Exposure. We have entered into somewhat lengthy explanation of its treatment of the elements of Construction and Occupancy. We have seen how this treatment works into the finished rate on the building standing unprotected and unexposed. There remains the treatment of Protection and Exposure to make our study complete.

PROTECTION.

The many methods of protection against fire are classed as public and private. With reference to public protection all of the buildings within reach of that protection are given the same percentage credit. With reference to private protection each building is given the credit to which the private devices of protection installed in that building entitle it. Public protection is general; private is individual.

Classification of Public Protection.

Before any adequate method of recognition of public protection in the rate can be formulated, we must seek some classification of such protection. You will find no classification of public protection in the Analytic System. It is content with the statement, "Municipal protection is divided into seven grades to conform to the * * * classification by the Western Union." If we turn to this classification we find a necessarily elaborate pamphlet dividing all cities and towns into seven classes, which we may roughly define as follows:

First Class.

Waterworks. Gravity, combined or direct pressure system, with reservoir or standpipe, pumps and boilers of specified capacity and with pumping station, pressure, mains, gate valves and hydrants as specified. Approved high pressure system.

Fire Department. Equipment of apparatus, full-paid men, hose and telegraph fire alarm system as specified.

Ordinances. Approved building, electrical and general ordinances. Streets of standard width, paved and lighted.

Second Class.

Waterworks. Same as first class, except pumping station may be brick instead of "fire resistive," and a slight deficiency may exist in location of gate valves. No high pressure system.

Fire Department. Same as first class, except requirement for number of men may be reduced as specified.

Ordinances. Same as first class, except that wires need not be installed in underground conduits.

Third Class.

Waterworks. Pressure mains and hydrants same as first class. Other requirements not less than 75 per cent. of first class. Force mains need not be in duplicate. Pumping station same as second class.

Fire Department. Same as first class, except requirement for number of men may be reduced as specified. Fire alarm system need be only 75 per cent. of first class.

Ordinances. Suitable, but without special supervision. Streets, however, to be same as first class.

Fourth Class.

Waterworks. System may be 50 per cent. of first class, mains and hydrants slightly deficient, but pressure standard.

Fire Department. Organized and well-drilled volunteer. To be paid for services rendered. Not less than one hook and ladder truck and one hose reel with 1,500 feet of standard hose, drawn by horses. Satisfactory telephone system for fire alarm.

Ordinances. Same as third class. Streets same as first class in business district.

Four and One-Half Class.

Waterworks. System not up to standard of fourth class.

Fire Department. Slightly deficient from fourth class.

Ordinances. None.

Fifth Class.

Waterworks. None.

Fire Department. Volunteer with one hand engine, 500 feet of standard hose and public cisterns. A double-tank chemical engine may be used in place of a hand engine.

Ordinances. None.

Sixth Class.

No fire protection.

Credit on Building Rates.

With this classification before us, we turn to the Analytic System to discover its method of treatment. An examination of previous schedules reveals an average rate as made by them on frame buildings under full city protection equal to about two-thirds or 66 2-3 per cent. of the average rate on frame buildings without protection. In the case of brick buildings the hazard under city protection is about 55 per cent. of that without protection. This relation is equalled approximately under the Analytic System by successive discounts, from the rate without protection, of 8 per cent for each class of protection in the case of frame buildings, and of 13 per cent. in the case of brick buildings. Instead of making this discount from the final rates, however, which would necessitate a separate figuration for each building, the discount is made from the basis rates and a basis rate table established. This operation makes unnecessary a separate figuration for each building and produces the same result as the discount from the final rate, due to the fact already stated that a percentage change in basis rate produces a like change in the final rate.

An illustration of this figuration as applied to the actual formation of a basis rate table will, perhaps, make this clear to you. Assume the brick basis rate without protection to be \$1.00. If we were to discount this amount regularly, 13 per cent. for each class as noted above, we would simply divide \$1.00 by 113 per cent., the resulting amount by 113 per cent., etc. This has been done, except in the case of the basis rates for four and one-half and fifth classes. The protection of fifth class is considered worth only a credit of one-half of 13 per cent., and the basis rate is, therefore, made the average between the sixth class basis rate and the figure obtained by the first discount of 13 per cent. Thus $1.00 \div 1.13 = .88$; $1.00 + .88 = 1.88 \div 2 = .94$. The differences between the protection of fifth class and four and one-half class and between four and one-half class and fourth class are considered worth three-fourths of a class respectively. The four and one-half class basis is thus half way between fourth and fifth class basis rates and is obtained by taking the average of same. As the fourth class basis rate is two classes or two discounts of 13 per cent. removed from the sixth class basis, it is obtained thus: $1.00 \div 1.13 = .88$; $.88 \div 1.13 = .78$. The four and one-half class basis rate is therefore $.94 + .78 = 1.72 \div 2 = .86$. The third class basis rate is obtained by figuring a discount of 13 per cent. from fourth class; second class, by the same discount from

third class, etc. The brick basis rate table No. 100 for a 1-story building is thus figured and shown herewith:

	Class 1	Class 2	Class 3	Class 4	Class 4½	Class 5	Class 6
1 story	\$0.54	\$0.61	\$0.69	\$0.78	\$0.86	\$0.94	\$1.00

As explained under our treatment of height in the paper on Construction, the basis rates are increased for each story over one. In the formation of the tables this increase was applied to the sixth class basis rate, and the discounts described above then applied to the resulting basis rates for buildings of various heights. This resulted in the following table as it appears in the schedule:

Brick Basis Table No. 100.

	Class 1	Class 2	Class 3	Class 4	Class 4½	Class 5	Class 6
1 story	\$0.54	\$0.61	\$0.69	\$0.78	\$0.86	\$0.94	\$1.00
2 stories	.57	.64	.73	.82	.91	.99	1.05
3 stories	.60	.67	.76	.86	.95	1.04	1.10
4 stories	.63	.72	.81	.92	1.01	1.10	1.17
5 stories	.69	.78	.88				
6 stories	.76						
Increase for each additional story..	.12	.12	.12	.12	.12	.12	.12
Decrease if no base- ment	.03	.03	.04	.04	.04	.05	.05

A series of basis rate tables ranging from No. 60 up to No. 120 was then figured from the 100 table by taking fixed percentages of it. Thus the 60 table is 60 per cent. of the 100 table, etc.

Frame basis rate table No. 100 was figured in the same way as brick table No. 100, except that the discount of 8 per cent. was used in place of 13 per cent. The series of frame tables ranging from No. 90 up to No. 250 was then constructed. Frame basis rate table No. 100 appears thus:

Frame Basis Table No. 100.

	Class 1	Class 2	Class 3	Class 4	Class 4½	Class 5	Class 6
1 story	\$0.68	\$0.74	\$0.79	\$0.86	\$0.91	\$0.96	\$1.00
2 stories	.71	.78	.83	.90	.96	1.01	1.05
3 stories	.76	.83	.88	.96	1.02	1.08	1.12

We now have two series of basis rate tables, one for brick and one for frame, by means of which we not only give proper credit for public fire protection and proper charges for height, but also by proper selection of which for any state we can make rates at

the level which experience justifies. The selections of the brick and frame tables are entirely independent of each other.

"Starred" Risks.

A comparison of the basis rate tables given above will show that less credit is given a frame building for public fire protection than is given a brick building. This, of course, must be true, since the discount for brick was 13 per cent. and for frames 8 per cent. When the building is filled with a stock which burns rapidly and fiercely, such as hay, it is not considered entitled to as much credit for public protection as the building with the usual occupancy. The fire department finds the fire well under way upon arrival and fire protection is less effective against the intense heat. Buildings containing such occupancies are called "starred risks" for the reason that such occupancies in the alphabetical lists are designated with a star to show that when found in a building, that building should receive less credit for fire protection. As this principle was already used in the different discounts in the case of brick and frame buildings, it was decided to give brick starred risks one-third less credit than brick buildings of regular occupancy, and frame starred risks one-half the credit allowed frame buildings of regular occupancy. This amounts to a discount for each class of public protection of about 8 per cent. for brick and 4 per cent. for frame starred risks. Instead of constructing new basis tables along these lines, as would have been entirely possible, scales of increase of the regular brick and frame basis were provided, which produced approximately the same results. These scales of increase are placed immediately preceding each occupancy list. When a starred risk such as a hay barn is to be rated, the regular basis rate can be increased by the percentage given for the class of protection which applies, and used as a new basis rate.

Credit on Contents Rates.

In the matter of difference between rate on buildings and on contents, the Analytical System considers that public fire protection should play a part. As already pointed out in the discussion of contents, statistics show that the better the fire protection, the greater the relative loss on contents as compared to building. Whereas in unprotected towns statistics may show a loss on contents of brick buildings slightly in excess of the loss on buildings, they show in first class cities a loss on contents greatly in excess of that on buildings. This is due partly to the superior construction of buildings under the better grades of protection and the

ability of the firemen to extinguish the fire with small loss to the building, also to the increased value of stocks subject to one fire as well as the greater loss by water under higher grades of protection. This simply means that stocks should not receive as much credit for fire protection as do buildings; that the contents differential should increase as the protection is improved.

With these ideas in mind the tables of contents differentials were constructed, as we have partially described under our treatment of Damageability. In an unprotected town where the hazard of the building was assumed as represented by a rate of \$1.00, the relative hazard of contents of different grades of damageability was regarded as represented by a rate of \$1.10 on a D1 stock, \$1.20 on D2, \$1.40 on D3, and \$1.60 on a D4 stock. Whereas the hazard of a brick building was discounted 13 per cent. for each grade of public fire protection, a D1 stock was discounted 5 per cent, D2 2 per cent., D3 1 per cent., and D4 0 per cent. Rates on stocks for each class of damageability under each grade of protection were thus figured, and when the rate on building for each class was subtracted, resulted in a table of contents differentials. The grades D1½, D2½ and D3½ were figured halfway between the regular grades. The additions for location of stock in basement or above grade floor were then applied as already described under damageability and contents table No. 100 thus figured. Tables ranging from No. 60 to No. 95 were then computed by taking a constant percentage, for each table, of the 100 contents table. In actual practice the selection of the proper table is made by experience. The same table is used for all classes of towns in a given State. A diagram showing Contents Table No. 70 for sixth class has already been shown under our treatment of damageability, but by way of further illustration, I give you that part of the same table which applies to first class cities.

Contents Table No. 70. First Class Protection.

	D1	D1½	D2	D2½	D3	D3½	D4
Basement	\$0.30	\$0.39	\$0.47	\$0.57	\$0.66	\$0.76	\$0.86
Ground floor.....	.22	.30	.38	.47	.55	.65	.74
Second floor.....	.30	.39	.47	.57	.66	.76	.86
Third floor.....	.35	.44	.53	.63	.72	.83	.93
Fourth floor.....	.40	.50	.59	.69	.79	.90	1.01
Fifth floor.....	.45	.55	.65	.76	.86	.97	1.08
Sixth floor.....	.51	.61	.71	.82	.93	1.05	1.16
Seventh floor.....	.56	.67	.77	.89	1.00	1.12	1.24
Eighth floor and over..	.61	.72	.83	.95	1.06	1.19	1.31

As the contents differential is thus shown to be an expression of the difference in hazard between buildings and contents, the differential in starred risks under protection should be less than in ordinary risks. This is obvious since the less the credit given for protection the smaller the differential, and a starred risk, as already stated, receives less credit for protection than an ordinary risk. The amount of deductions was easily figured for each class of protection and the amount placed at the head of each class under each table. The notation under Contents Table No. 70, first class, shown above, for instance, reads: "Deduct 11 cents for star".

The above remarks on contents differential also apply in the case of frame buildings, but to a lesser degree. Since the frame building is more damageable and receives less credit for protection than the brick, the contents differential should, of course, be smaller.

The schedule for the present at least, contents itself with the provision of *one* frame contents table. Although the differentials in this table are not figured as exactly as in the case of brick tables, they can be so figured in case the margin of profit on such contents makes a closer analysis necessary in the future.

Frame Contents Table.

	D. 1 & 1½	D. 2 & 2½	D. 3 & 3½	D. 4
In towns of classes 5 and 6			10c	14c
In towns of classes 4 and 4½			13c	17c
In cities of class 3		8c	16c	20c
In cities of classes 1 and 2		14c	20c	25c

Private Protection.

Having thus seen how the schedule gives proper credit for public protection, we turn next to private protection. Public protection deals with waterworks, fire department and city ordinances. Private protection deals with inside standpipes, watchman, chemical extinguishers, etc. In the former case, the same credit is given all buildings reached by the protection, in the shape of a percentage discount from the basis rates, resulting in the establishment of basis rates for that city. In the case of private protection, credit is given only to those buildings which are protected. This credit is a percentage of the final rate of building (not including exposures). Although applied in different places, a moment's reflection will convince you that the results of the two methods are identical. The credit for private protection applies to the final rate for convenience only. Without needless explanation, I give you the following:

Table of Credits for Protective Features (Private).

1. Inside standpipe and hose.....	5%
2. Outside fire escape and standpipes on buildings 3-stories and over	4%
3. Automatic fire alarm system.....	10%
4. Chemical extinguishers or casks and pails.....	5%
5. Watchman with approved clock.....	5%
6. Watchman reporting to central station.....	10%
8. Heat from outside source or no heat.....	5%
9. Approved whitewash or fire-proof paint on all exposed in- terior woodwork	2%

EXPOSURES.

Up to the present we have considered all buildings as standing entirely alone. In very few instances, however, do we find buildings so situated as not to be affected by the burning of surrounding buildings. We live in cities and we erect our buildings in large groups, so crowded together that too often a fire in one building results in a conflagration. We must make rates for a gregarious people. The measurement of this hazard is a difficult one, and, strange to say, was the problem which gave birth to the Analytical System. Mr. Dean did not wish to formulate a schedule of rating. His original intention was to devise some means of making exposure charges, to offer some defensible scheme of measuring exposure hazard. Many previous schedules were silent on this vital point; others merely offered crude tables of charges. The insurance business needed some method of treatment that would give the companies adequate return for the liability assumed and offer defensible inducement for the removing of exposure hazard by protection of openings and erection of fire walls. After he had formulated his exposure rules he wished them tested, and, finding no tariff for frame buildings working satisfactorily enough to give adequate tests, he devised and printed with the exposure rules a simple frame tariff. This was first tested in the small towns of Illinois in the latter part of 1902. For about a year the schedule consisted of a small pamphlet of forty pages printed in the back part of the Minimum Tariff of the Illinois State Board of Fire Underwriters. It contained no provision for brick buildings, the Illinois State Board Tariff providing for that class. The schedule for brick buildings was then added, and, later still, the frame schedule was revised along the lines of the newer brick. Slowly the schedule

grew, and as it grew it came into use more widely. From its start in the small towns of Illinois it spread to other States and to the larger towns. Today it is used throughout the entire Middle West, from Nebraska to West Virginia, and from Minnesota to Tennessee, and in all the larger towns and big cities, with but few exceptions. The Analytic System did not spring forth complete, like Minerva, fully armed, from the head of Jupiter. It has been a growth, a process of evolution. In its growth it has truly been tested with fire as no other schedule has ever been. This growth is not complete even now. Evolution does not stop. The schedule is not perfect; I could point out many faults. But the principle is there and remains unchanged, always ready to be called upon to give what help it can to place our business upon a sound and uniform foundation.

Mr. R. M. Bissell, in his lectures before Yale University, makes the statement that 28 per cent. of all losses, both as to number and value, is due to exposure fires. To provide a proper method of treatment for so important an element of fire hazard and a scientific analysis of so complicated a problem was the task Mr. Dean set for himself in the formation of the exposure formulae. Mr. Bissell says that these formulae "will come to be recognized as exhibiting the most satisfactory, logical and adequate treatment known up to this time, of this highly complex and hitherto maltreated department of the science or business of making rates for mercantile risks."

Three Kinds of Exposure.

Mr. Dean did not attempt to use philosophy in this work, but merely common sense. He said that all buildings "radiate" a part of their own hazard to other buildings, "absorb" a part of the hazard of other buildings, and "transmit" a part of the hazard absorbed from buildings on one side or in one direction to buildings on the opposite side or in another direction. He said that the extent to which buildings radiate, absorb and transmit hazard depends upon the fire protection of the city or town, upon the construction of exposing and exposed walls, and upon the distance between the exposing and exposed walls.

Three Factors of Exposure.

Exposure must necessarily start with the rate on the exposing building, for that rate measures all the hazard of that building and its occupancy, including all features of wall construction, floor-

way openings, furnaces, public and private protection, etc. The ratio of this hazard which is radiated from the building depends upon the proportion of fires suppressed in the building, and this in turn depends, as stated first, upon the public fire protection. In fifth and sixth-class towns, the average of this ratio, as found in existing tariffs for frame buildings exposing frame buildings, is about 40 per cent. As the fire protection improves, it will be conceded that this ratio should decrease, and therefore $33\frac{1}{3}$ per cent. is used in fourth and four-and-a-half class towns, and 30 per cent. in first, second and third class. The amount in dollars and cents obtained by taking 40 per cent., $33\frac{1}{3}$ per cent. or 30 per cent. of the rate of the exposing building, as the case may be, is called the Exposure Standard, because it is the amount obtained by the use of a ratio which is uniform for all classes of buildings under each grade of protection.

The construction of the facing walls of the exposing and exposed buildings next plays its part. In towns of grades 4, $4\frac{1}{2}$, 5 and 6 the entire exposure standard figured above applies in the case of frame buildings exposing frame buildings. As the construction of either or both buildings becomes better, only part of this standard should apply. Accordingly graded decimal ratios of the standard are provided for all possible combinations of construction in exposing and exposed buildings, ranging from "all" or ten-tenths for frame building exposing frame building down to zero for a brick fire wall exposing another brick fire wall.

The use of the proper decimal ratio of the exposure standard gives us the amount of exposure to be absorbed by the exposed building, provided exposing and exposed building are situated immediately adjoining. Should clear space be found between the two buildings, this amount must be still further reduced, the amount of reduction depending, of course, not only upon the distance, but also upon the construction. The reduction for space should be greater, the better the construction. Graded fractional reductions for each ten feet clear space are therefore provided for the same combinations of construction in exposing and exposed buildings, as are provided in the case of the decimal ratios.

These two methods of reduction for construction and for space by means of decimal ratios and fractions, respectively, are presented for convenience in the form of a general exposure table, as follows:

General Exposure Table.

For use in town of grade 4, 4½, 5 or 6.

Exposing Buildings.

Frame	Frame or I. C. No. 1	I. C. No. 2 or Skele- ton I. C.	BRICK VENEERED			BRICK SHINGLE ROOF		Brick Metal Roof
			B. V. No. 1	B. V. No. 2	B. V. No. 3	C. No. 1	C. No. 2	B. No. 1
All	All	All	.7	.6	.5	.4	.3	.3
1/5	1/5	1/4	1/4	1/3	1/3	1/3	1/3	1/2
Iron Clad	All	All	.6	.5	.4	.3	.3	.3
No. 1 With exposed openings	1/5	1/4	1/4	1/3	1/3	1/3	1/2	1/2
No. 2 Without exposed openings	All	All	.5	.4	.3	.3	.3	.2
	1/4	1/3	1/3	1/3	1/3	1/2	1/2	1/2
Brick Veneered	All	All	.6	.5	.5	.3	.3	.3
No. 1 With shingle roof or wooden mansard	1/5	1/4	1/4	1/3	1/3	1/3	1/3	1/2
No. 2 With metal roof and no parapet or with unprotected openings	.7	.6	.6	.5	.4	.3	.2	.2
	1/4	1/4	1/3	1/3	1/3	1/3	1/2	1/2
No. 3 With metal roof and parapet 12 in. high. No unprotected openings.	.6	.5	.5	.3	.2	.2	.0	.0
	1/3	1/3	1/3	1/2	1/2	1/2		
Brick Shingle Roof	.6	.5	.5	.4	.4	.4	.3	.3
No. 1 Wooden mansard or shingle roof sloping towards exposure	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2
No. 2 Shingle roof and parapet wall with unprotected openings	.5	.5	.4	.3	.3	.3	.3	.2
	1/4	1/3	1/3	1/3	1/3	1/2	1/2	1/2
No. 3 Shingle roof and parapet wall, all openings protected	W. D.	W. D.	W. D.	.0	.0	.0	.0	.0
Brick Metal Roof	.4	.4	.3	.3	.2	.3	.2	.2
No. 1 Wall without parapet or with unprotected openings	1/4	1/3	1/3	1/2	1/2	1/2	1/2	1/2
No. 2 Parapet wall, all openings protected	W. D.	W. D.	W. D.	.0	.0	.0	.0	.0

At the top of this table you will note under the list of exposing buildings the names of all kinds of buildings from frame to brick. The numbers under each class, such as brick-veneered No. 1. No. 2 and No. 3, are used to designate the different types of construction of that class, which, of course, are defined. Brick-veneered No. 1, for instance, is defined as a brick-veneered building "with shingle roof or wooden mansard;" brick-veneered No. 2 as a brick-veneered building "with metal roof and no parapet, or with unprotected openings," and brick-veneered No. 3 as a brick-veneered building "with metal roof and parapet twelve inches high and with no unprotected openings."

At the left-hand side of this table you will note the same list of buildings as "exposed buildings," except with the addition of "C. No. 3" and "B. No. 2" buildings. A "C. No. 3" building is defined as a brick building with a "shingle roof and parapet wall, all openings protected," and a "B. No. 2" building as a brick building with a metal roof and parapet wall, all openings protected. These two classes were not included in the headings at the top of the table for the reason that they are not considered as radiating any exposure.

Under the name of the class which applies to the construction of the exposing building and on a level with the name of the class which applies to the construction of the exposed building will be found the proper decimal ratio to be applied to the exposure standard whenever that combination in construction of exposing and exposed buildings is found. And immediately under the decimal ratio will be found, in each case, the fraction which designates what part of the exposure charge thus figured is to be deducted for each ten feet clear space between exposing and exposed buildings for the same combination of construction. If, for instance, a "B. V. No. 2" building exposes a frame building we find under "B. V. No. 2" and on a level with "frame" the decimal .7 and fraction $\frac{1}{4}$; but if a "B. V. No. 2" building exposes a "C. No. 2" building we find the decimal .3 and the fraction $\frac{1}{3}$. If the rate on the "B. V. No. 2" building were \$2.00, the percentage used to figure the exposure standard 40 per cent. and the clear space between the exposing and exposed building 20 feet, the exposure standard of the radiated exposure of said building would be 40 per cent. of \$2.00, or 80 cents. The exposure charge from it to the frame building would be seven-tenths of 80 cents, or 56 cents, less $\frac{2}{4}$ for 20 feet space, leaving 28 cents; and the charge from it to the "C. No. 2" building would be three-tenths of 80 cents, or 24 cents, less $\frac{2}{3}$ for 20 feet space, or 8 cents.

It is interesting to note in passing that this table covers any one of 88 combinations of construction in exposing and exposed buildings, which gives one some idea with what completeness the Analytic System provides for that element of fire hazard which, at the best, has received but scant treatment in previous schedules.

Where the zero appears in the table, no exposure charge is to be made. Where the letters "W. D." appear, the charge is to be made by the rules for "wall damage," which will be discussed later. Where the word "All" appears, no decimal reduction of the exposure standard is to be made, the only reduction being for clear space. Where a frame or "I. C. No. 1" building exposes a frame building, you will notice no fraction is given, but the words "see

frame table" are inserted. This refers to a special table covering reductions for space between frame buildings as follows:

Distance between buildings—	Decimal Ratio of Standard.
Under 15 feet.....	All
15 feet and under 20 feet.....	.9
20 feet and under 25 feet.....	.7
25 feet and under 30 feet.....	.6
30 feet and under 35 feet.....	.5
35 feet and under 40 feet.....	.4
40 feet and under 45 feet.....	.3
45 feet and under 50 feet.....	.2
50 feet and under 60 feet.....	.1
60 feet	.0

In cities of classes 1, 2 and 3 practically the same methods are followed. The General Exposure Table given above is slightly changed, however, by substituting the decimal ".8" wherever the word "All" appears, and placing the fraction $\frac{1}{5}$ where the words "See Frame Table" appear. The latter change removes the necessity for the separate frame table and none is given for cities of these three classes.

Illustrations of Exposures.

With this explanation of the general exposure table we turn to examples illustrating its actual use in a few of the many complicated situations that arise. In these illustrations we shall use various terms which it seems best to define. We quote from the schedule:

"When the unexposed rate of a building has been computed by the * * * brick or frame tariff, this rate is referred to as its individual rate, or, if building has more than one occupancy, as its omnibus or multiple occupancy rate.

"The amount added to individual or omnibus rate for external exposure is referred to as the exposure load.

"The individual or omnibus rate plus exposure load is the final rate.

"A solid frame row is one where the greatest clear space between any two buildings is less than 15 feet in towns of class 4, 4½, 5 or 6.

"The highest rate (individual or omnibus) in a solid frame row is referred to as the nuclear rate, because exposure charges are added to this as a nucleus."

The operation of figuring exposure charges among the build-

ings of a solid frame row is very simple. After the rate on each building has been figured as though it were unexposed, the exposure standards of all buildings in that row (except the one with the highest individual or omnibus rate) are added to the nuclear rate as defined above, and all buildings in the row take the result as their final rates. "When the final rate has been established, the exposure load of each building in the row may be found by subtracting its individual rate from the final rate."

Where contents are located on the ground floor of a building and are removable, the exposure load to contents should obviously be less than that to building. There is a possibility of removing part, at least, of such a stock of goods to a place of safety in the case of an exposure fire, which does not exist with reference to the building. Such stocks as clothing, dry goods, groceries, etc., are thus treated as removable and are given only 70 per cent. of the exposure load to building in fifth and sixth class towns, 80 per cent. in fourth and four-and-a-half class towns, and 90 per cent. in first, second and third class towns. Such stocks as stationery, drugs, music stores, etc., are treated as semi-removable and are given 80 per cent. of the exposure load to building in fifth and sixth class towns and 90 per cent. in fourth and four and a half class towns. The exposure load to stocks is thus relatively increased under the better grades because of the increased probability of water damage. In the case of ground floor stocks in brick buildings the above percentages of exposure load to building apply only to the amount of excess of such exposure load over 20 cents.

For purposes of illustration, we present the following example in exposures of a solid frame row, taken from the schedule:

Solid Frame Row.

	Bldg. No. 1	Bldg. No. 2	Bldg. No. 3
Occupancies—	Livery.	Black-smith.	Office.
Individual rates	\$3.00	\$2.25	\$1.25
Exposure 40% of others added to nuclear rate	1.40	....	....
	—	—	—
Final building rates.....	\$4.40	\$4.40	\$4.40
Individual rates subtracted.....	3.00	2.25	1.25
	—	—	—
Exposure loads to buildings.....	\$1.40	\$2.15	\$3.15
Exposure loads to removable contents (70%) .	.98	....	....
Exposure loads to semi-removable contents			
(80%) .....		....	2.52
Individual rates added.....	3.00	2.25	1.25
	—	—	—
Final rates on contents.....	\$3.98	\$4.40	\$3.77

The rating of an open frame row presents added complications. Let us assume 20 feet space between buildings Nos. 1 and 2 and also between buildings Nos. 2 and 3. The above solid frame row then becomes an open frame row and is rated thus:

Open Frame Row.

Occupancies	Bldg. No. 1 Livery	Bldg. No. 2 Black- smith.	Bldg. No. 3 Office.
Individual rates	\$3.00	\$2.25	\$1.25
Exposure No. 1 to others, 40% of \$3.00 equals \$1.20, multiplied by 70% for 20 feet space to No. 2.....		.84	....
And again by 70% for second 20 feet space to No. 3.....		....	.59
Exposure No. 2 to others, 40% of \$2.25 equals \$0.90, multiplied by 70% for 20 feet space to both Nos. 1 and 3.....	.63	....	.63
Exposure No. 3 to others, 40% of \$1.25 equals \$0.50, multiplied by 70% for 20 feet space to No. 2.....		.35	....
And again by 70% for second 20 feet space to No. 1.....	.24	....	....
Final building rates.....	\$3.87	\$3.44	\$2.47
Individual rates subtracted.....	3.00	2.25	1.25
Exposure loads to buildings.....	\$0.87	\$1.19	\$1.22
Exposure loads to removable contents (70%)..	.61	....	....
Exposure loads to semi-removable contents (80%) .....		....	.98
Individual rates added.....	3.00	2.25	1.25
Final rates on contents.....	\$3.61	\$3.44	\$2.23

Frame rows are frequently found which we might term as "mixed," that is, consisting of part open and part solid rows of frame buildings. In such cases each such solid row is grouped and treated as an individual building, as far as exposures from other buildings or rows are concerned. The exposure from it to other buildings or rows is based upon the sum of the individual rates of all buildings in that row. Otherwise the methods of procedure are the same as outlined above.

Buildings other than frame are divided into two classes, transparent and non-transparent. Buildings are regarded as transparent when all of the exposure standard is used in figuring exposure. Such buildings are designated by the word "All" in the general

exposure table, and are treated like frame buildings in all respects except that they are classed as solid rows when not separated by 10 feet or more instead of the 15 feet used for frame buildings, and that reductions for space are made by the fractions given instead of by the frame exposure table. All other buildings are regarded as non-transparent and are never grouped in solid rows. In the case of these buildings decimal ratios of the exposure standard are provided by the general exposure table, and reductions for space are made by the fractions given. We illustrate the method of figuring exposures in such a case. The distance between buildings Nos. 1 and 2 is assumed as 10 feet and between Nos. 2 and 3 as 20 feet.

Non-transparent Buildings.

Construction—	Bldg. No. 1, Brick metal roof with openings in walls.	Bldg. No. 2, Brick veneered, metal roof with openings.	Bldg. No. 3, Brick, shingle roof.
Individual rates	\$1.00	\$2.00	\$1.50
Exposure No. 1 to others, 40% of \$1.00 equals \$0.40, multiplied by .2 equals .08 (B. No. 1 to B. V. No. 2) reduced $\frac{1}{2}$ for 10 feet space		.04	....
\$0.04 multiplied by .4 equals .02 (B. V. No. 2 to C. No. 1), reduced $\frac{2}{3}$ for 20 feet space .....		....	.01
Exposure No. 2 to others, 40% of \$2.00 equals \$0.80, multiplied by .3 (B. V. No. 2 to B. No. 1) equals .24 reduced $\frac{1}{2}$ for 10 feet space	.12	....	....
\$0.80 multiplied by .4 (B. V. No. 2 to C. No. 1) equals .32 reduced $\frac{2}{3}$ for 20 feet space .....		....	.11
Exposure No. 3 to others, 40% of \$1.50 equals \$0.60, multiplied by .3 (C. No. 1 to B. V. No. 2), equals .18, reduced $\frac{2}{3}$ for 20 feet space.....		.06	....
\$0.06 multiplied by .3 (B. V. No. 2 to B. No. 1) equals .02, reduced $\frac{1}{2}$ for 10 feet space	.01	....	....
Final building rates	\$1.13	\$2.10	\$1.62

Abnormal Exposures.

In order to avoid confusion, I have purposely omitted up to this time to mention that all of the foregoing explanation of exposure charges applies to buildings of the average area and height found in mercantile buildings. When area or height exceeds this average it becomes necessary to provide special treatment, whereby the regular charges can be properly increased to care for the increased hazard. When the area of a one-story building becomes much less than the average, it becomes necessary to provide special treatment whereby the regular charges can be properly decreased to care for the decreased hazard. For these reasons exposures are graded as normal and abnormal. Normal exposures have been treated above. Abnormal exposures are graded as Nil, Negligible, Small and Large. "Nil indicates structures so small that they may be ignored both as to the exposure they radiate and transmit. Negligible indicates risks so small or of such low hazard that their radiated exposure may be ignored, though they should be recognized as transmitting exposure between other buildings. Small and Large indicate buildings which, according to their size, radiate either more or less exposure than ordinary mercantile or light industrial buildings as found in the business districts of towns and cities."

In order that there may be uniformity in the grading of buildings, the following Dimension Table is provided, "containing estimates of dimensions of large, small and negligible buildings:"

Dimension Table.

		Grades of Protection.			
		Class 1, 2 and 3.		Class 4, 4½, 5 and 6.	
		Stories.	Gd. fl. area.	Stories.	Gd. fl. area.
Frames, iron-clads and brick veneered.	Large..	1	8000	1	5000
	" ..	2	5000	2	3000
	" .. 3 or over	All bldgs.		3 or over	All bldgs.
	Small..	1	1000	1	750
	" ..	2	400	.....	.....
	Negligible..	1	400	1	300
Bricks	Large..	1	12000	1	8000
	" ..	2	8000	2	5000
	" ..	3	5000	3	3000
	" .. 4 or over	All bldgs.		4 or over	All bldgs.
	Small..	1	1000	1	750
	" ..	2	500	.....	.....
	Negligible..	1	500	1	400

Thus a one-story frame building in a fifth-class town grades as large if its ground floor area is 5,000 square feet or over, and

as small if its ground floor area is 750 square feet or less. Between these two dimensions it grades as ordinary or normal. In case buildings are used for extra hazardous occupancies, such as a starred risk, the dimensions in the table are reduced one-half.

The method of charging exposures from buildings which grade as large or small, by the above table, is comparatively simple. In the case of frame buildings the method is the same as for ordinary exposure except that the Frame Exposure Table shown above is modified to provide smaller reductions for space where the building grades as large, and larger reductions where the building grades as small. In the case of other buildings covered by the General Exposure Table the following method is provided:

"Small. Refer to General Exposure Tables and lower the decimal and the denominator of the fraction showing the reduction for space, each one point; i. e., if the decimal is .3 and the fraction beneath $1/3$, change to .2 and $1/2$, and figure out the result as for ordinary exposures.

"Large. Raise the decimal and the denominator of its fraction in General Exposure Tables two points increasing each again one point for each additional story in excess of the smallest number of stories, which would grade building as large regardless of area, until the decimal and its denominator reach ten."

Special Features of Exposure.

The foregoing comprise all of the more essential features of exposure as covered by the Analytic System. There are a few special features which we will mention before concluding our study.

Falling Wall Exposure is charged "when a building is exposed to damage from falling wall of a brick or stone building." A charge of 2 per cent. of the rate of the exposing building is made if the exposing wall is two stories higher, increased 1 per cent. for each story over two.

Wall Damage Exposure is charged when the letters "W. D." are found in the General Exposure Table. The charge covers the damage done to a brick or stone fire wall by an exposing building. It consists of 10 per cent. of the basis rate of the exposing building plus 5 per cent. of the excess of its final rate over the basis rate. One-fourth of the charge is deducted for each 5 feet of clear space in fourth, four-and-a-half, fifth and sixth class towns, and a further reduction of 20 per cent. is made in fourth and four-and-a-half class towns. In cities of Classes 1, 2 and 3. one-third is deducted for each 5 feet of space, and the further reduction is 40 per cent. One-half of the net charge is added to the

contents rate under all grades of protection, except first, second and third, where no charge to contents is made.

Buildings of unequal height present many small but difficult problems under exposure, as do also buildings of unequal length. The schedule devotes two full pages to these problems, such as the amount of exposure to be charged to a brick building exposed by a higher frame building for varying heights of parapet on the brick building, or to a brick building with openings above the roof of a lower brick or frame building, or to a brick building when an exposing frame building projects beyond its rear.

Angular exposures are charged when the exposing and exposed walls are not parallel, or when window openings in same are not opposite or are so located as to constitute a less exposure hazard than otherwise. Angular exposures are graded as "Diagonal" and "Glancing," depending upon the degree of the hazard as compared to full or direct exposure. The methods used in charging direct exposures are used for angular exposures, except that the final charge is reduced one-half for "Diagonal" and three-fourths for "Glancing."

Fire-stop walls are sometimes built in frame rows, and when so found are treated as the equivalent of clear space in figuring exposures from one side of the wall to the other. The amount of clear space for which credit is given depends upon the height of the wall and the kinds of roof upon the buildings on both sides.

Selective exposures are sometimes found among buildings or groups located "in such manner that it is possible to measure the exposure in more than one way. In such cases it should be borne in mind that exposure flows through the channel of greatest hazard, and should be figured in the way that produces the highest exposure charge."

When two adjoining buildings or sections of a building are separated by a division or fire wall, with all openings protected by standard fire doors, an exposure charge is made from each building or division to the communicating building or division. This charge is based upon the assumption that a fire wall with openings so protected is not as good a cut-off as a blank wall. The charge is a percentage of the individual rate of the exposing building, and increases with the combustibility of the stock of the exposing building and the damageability of the stock of the exposed building. A larger charge is made for a communication with a standard door on one side of the division wall than for a communication with a standard door on each side. The charge is increased one-fifth for each opening over one up to double the charge. Total charge should in no case exceed 80 per cent. of the increase that would result if both buildings were rated as one risk.

A small charge, called "Starred Risk Exposure," is made from a starred risk through a party or division wall without openings. In much the same manner, when a building contains explosive contents, 5 per cent. of its individual rate is charged through a party or division wall.

With "Starred Risk" and "Explosion" exposure we complete the study of exposure and approach the conclusion of our study of the Analytic System. The predominating impression left by such a concise discussion of the details of the schedule is necessarily one of confusion. The one question which doubtless has been in your minds most frequently has had reference to the practicability of such close analysis, such completeness. Why go to the large expense of the application of such a complicated schedule? Do all of these minor features of a building and its occupancy warrant specific treatment? Perhaps I can best answer this vital question by quoting from a very recent utterance by Mr. Dean:

"Nothing, perhaps, more clearly shows the universal necessity for measurement than the fact that as competition increases and the necessity for a more rigid application of economics is forced upon each industry, there is a corresponding demand for an increasing nicety of distinction and finer discriminations in its measurements. When there is little competition and profits are large and sure in any given branch of industry, prices may be arbitrarily fixed without close computations, but when everybody is sailing close to the shore of cost, every item counts and measurements necessarily become more minute. * * * Comparisons of fire insurance rates spring up from all corners of the land. When a risk is rated this week, say, in Minneapolis, the owners of like risks in Oklahoma City or Columbus, Ohio, are likely to be heard from next week wanting to know why they are discriminated against, and it is necessary to satisfy the complainants by a detailed comparison, item by item. All this is the result of publicity and comparison between the membership in mercantile and manufacturing associations, and to an even greater degree to comparisons made by trusts, of the rates made on their widely scattered properties. All these criticisms resulting from the spread of information and comparison can be met only by the application of schedules that take account of every tangible feature of hazard."

In closing this somewhat lengthy presentation of the principles and methods of operation of the Analytic System, I have a confession to make. As we have moved through this large amount of detail the temptation has often been strong to pass over the comparatively uninteresting parts and give you a less monotonous and therefore more popular treatment of the schedule, such a treatment, perhaps, as would have interested the intelligent property

owner. But I have thought that your purpose, and I know that my purpose has been deeper than that. I have thought that your club desired to be the sponsor of perhaps the first serious detailed commentary on the system and I have attempted to give that to you to the best of my ability. Sacrificing mere superficial discussion of the schedule, we have attempted to give it a thorough exposition from cover to cover, such an exposition as cannot be grasped by one unfamiliar with rating systems in one evening or several evenings, but one that will bear future thought and study. You have been remarkably patient with this attempt and I thank you cordially for your kindness. Familiarize yourselves with the schedule and then watch with interest and intelligence, as the Analytic System like the soul of old John Brown goes "marching on."

Example
OF
Block Rating

March 23, 1909

INDIVIDUAL RATES.

Building No. 1. Basis rate, 1-story frame (B, page 7)		\$0.82
Area, 50 ft. x 30 ft. equals 1,500 square ft. on one floor, no charge (B, page 9, item 1).		
Chimney on brackets (B, page 9, item 3a).....	8%	
Occupancy, Drugs, 60% plus 20% (B, page 21)...	80%	
Paints and oils kept (C, page 24, item d).....	10%	
Total	98%	
Credit, approved composition roof (B, page 9, item 4)	10%	
Net	88%	.72
Individual rate		\$1.54
Building No. 2. Basis rate, 1-story frame (B, page 7)		\$0.82
Area, 75 ft. x 30 ft. equals 2,250 square ft. on 1 floor, no charge (B, page 9, item 1).		
Foundation open (B, page 9, item 2).....	8%	
Occupancy, Grocery (B, page 26).....	50%	
Total	58%	.48
Individual rate		\$1.30
Building No. 3. Basis rate, 2-story brick (A, page 16)		\$0.49
Area, 60 ft. x 30 ft. equals 1,800 square ft. on 1 floor (A, page 20).....	2%	
Walls, 12 12, standard (A, page 11), no charge (A, page 21, item 2a).		
Parapets, Left, building 1 story lower, no charge (D, page 28, item h).		
Right, 12 inches high (A, pages 10 and 21, item 2c)	2%	
Cornice wood, not cut off (A, page 24, item 10c) ..	5%	
Occupancy, Bank, no charge (A, page 29).		
Dwelling, no charge (A, page 43).		
Total	9%	.04
Individual rate		\$0.53

Building No. 4. Basis rate, 2-story frame (B, page 7)	\$0.86
Area, 35 ft. x 60 ft. equals 2,100 square ft. on 1½ floors, no charge (B, page 9, item 1).	
Stove pipe through roof (B, page 9, item 3d)....	20%
Occupancy, Meats, see Butcher Shops (B, page 16)	50%
Rendering Kettle on wood floor, (C2), see furnace table (C, page 18, fixed furnace with kettle), 25% doubled account wood floor (C, page 19, item 3).....	50%
Dwelling, no charge (B, page 21).	
Total	120%
	1.03
Individual rate	\$1.89
Building No. 5. Basis rate, 2-story brick (A, page 16)	\$0.49
Area, 75 ft. x 100 ft. equals 7,500 square feet on 1½ floors (A, page 20).....	11%
Side Walls, no charge (A, page 21, item 2a).	
Front Wall, iron and glass, 2 stories (A, page 22, item 2h).....	3% plus 2% equals 5%
Parapets, Right, building 4 stories higher, no charge (D, page 28, item h).	
Left, standard, no charge.	
Ceiling, wood, 1st floor (A, page 22, item 4a)....	2%
Floorway openings:	
First floorway (between basement and 1st story); floor is double 1-inch stuff not ceiled and therefore grades as "B" (A, page 12); openings, 5 stairs and 1 elevator, unprotected, and therefore grades as "below a" (A, page 13); charge is 5%+5% (A, page 22, item 7).....	10%
Second floorway (between 1st and 2nd stories); floor is double ceiled and therefore grades as "B" (A, page 12); no openings except stairs from street to second story, enclosed in wood-lath and plaster partition, and therefore grades as "a" (A, page 13); no charge (A, page 22, item 7).	
Partitions between occupants on ground floor and basement, wood, two (A, page 23, item 8a)...	6%

Occupancy, Millinery, retail, 3 trimmers, (A, page 61).....	10%	20%
Tailor Shop, 2 hands, (A, page 78) ..	10%	10%
Plumbing Shop, 2 hands, (A, page 68) ..	10%	10%
2 charcoal soldering pots (C2) (see furnace table (C) page 18, hand furnace), 7% plus 1/5 account 1 additional pot (C, page 19, item 2)	8%	
Coffees and Teas (A, page 37)	5%	10%
Hall (Lodge) (A, page 50)	3%	
Occupancy charge is sum of column 1 charges add- ed to highest column 2 charge (10% plus 10% plus 10 % plus 8 % plus 5% plus 3% equals 46% added to 20%		66%

Total	100%	.49
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Occupied building rate (gross)		\$0.98
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Credit, steam heat from outside source (A, page 87, item g)	5%	.05
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Individual rate		\$0.93
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Building No. 6. Basis rate, 6-story brick (A, page 16), .55 plus .07 and .07		\$0.69
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Area, 100 ft. x 50 ft. equals 5,000 square ft. on 6 floors (A, page 20)	22%	
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Supporting walls, right, party, ordinary occupancy, average thickness 18 inches, which is deficient 1 inch from standard of 19 inches (A, page 11) ; charge (A, page 21, item 2a)	1%	
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Not ledged (A, page 12, item a), charge (A, page 21, item 2b)	6%	
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Left, exterior, average thickness 18 inches, which is deficient 1 inch from standard of 19 inches (A, page 11) ; charge (A, page 21, item 2a) ..	1%	
--	----	--

Parapets, Right and Left, exposing buildings 1 story or more lower, no charge (D, page 28, item h) ..		
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Floorway openings:

All floorways are double 1-inch stuff without ceiling and therefore grade as "B" (A, page 12) ; 1 elevator through all floorways protected by automatic traps of 1-inch

stuff covered with tin on under side and therefore grading as "a" (A, page 13); 1 dumb waiter through three lower floorways protected by automatic traps same as elevator; 1 stairway through all floorways unprotected and therefore grading as "below a" (A, page 13). Charge for 6 floorways ("B") with one opening in each floorway ("below a"), 6×5% (A, page 22) 30%		
Occupancy, Liquors, wholesale (A, page 57) 5%		
plus 10%	15%	
Rectifying, cold process, 2 hands, charge labor (C2) (C, page 14).....	10%	
• Open motor (C2) (D, page 15).....	10%	
Total	95%	.65
Occupied building rate (gross).....		\$1.35
Credits for protective features (A, page 86).		
Outside standpipe and fire escape.....	4%	
Approved chemical extinguishers.....	5%	
Total credits	9%	.12
Individual rate		\$1.23
Building No. 7. Basis rate, 5-story brick (A, page 16). .55 plus .07.....		\$0.62
Area, 65 ft. x 95 ft. equals 6,175 square ft. on 6 floors including basement (A, page 20).....	26%	
Supporting walls, Right, exterior, average thickness 16 inches, which is deficient 4 inches from standard of 18 inches (A, page 12); charge (A, page 21, item 2a).....	2%	
Left, party, average thickness 19 inches, which is standard, no charge.		
Not ledged (A, page 12, item a), charge (A, page 21, item 2b).....	6%	
Parapets, Right unexposed, no charge (A, page 21, item 2c, note).		
Left, adjoining building 1 story higher with opening 18 inches above roof, no charge (D, page 28, items h and k).		
Total deficiency charge.....	34%	

Floorway openings:

All floorways are semi-mill construction and therefore grade as "C" (A, page 12); stairway and dumb waiter in brick shaft through roof with standard automatic fire doors on openings and therefore grading "d" (A, page 13); 1 elevator from basement to 5th story with openings protected by standard tin-clad automatic traps, and therefore grading as "c" (A, page 13), Credit for 5 floorways ("C") with retinue "c," 5×2% (A, page 22)..... 10%

Net deficiency charge..... 24%

Occupancy, candy factory and bakery (A, page 34), 25% plus 40%..... 65%

65 hands, additional labor (C3½) (C, page 14). 42%

6 open motors (C3½) (C, page 15), 20% plus 5/5 of 20% (C, page 16, item 1a)..... 40%

Furnaces, see furnace table (C3½) (C, page 18); 3 ovens, coke fuel, 35% plus 2/5 of 35% (C, page 19, item 2) equals 49%; 5 candy kettles, gas fuel, 55% plus 4/5 of 55% equals 99% (C, page 19, item 2) reduced ½ for gas fuel (C, page 19, item 1a) equals 50%; total charge, 49% plus 50% equals 99%; maximum charge, 35%×2 (C, page 19, item 2, note)..... 70%

• Total 241% 1.49

Occupied building rate (gross)..... \$2.11

Credits (A, page 86):

Structural features. All floorways grade as "C" (item b)..... 10% .21

\$1.90

Protective features. Inside standpipe and hose 5% .09

Individual rate \$1.81

EXPOSURES.

Exposure standard for a fourth class town is $33\frac{1}{3}\%$ of the individual rate (D, pages 3 and 4 and column 2 in table, page 4).

Exposure buildings Nos. 1 and 2 to building No. 3:

Buildings 1 and 2 are a solid frame row (D, page 9) and therefore radiate exposure as if they were one building bearing a rate equal to the total rates of the two buildings (D, page 16, note). Exposure standard is therefore 1.54 plus 1.30 equals $2.84 \times 33\frac{1}{3}\%$ equals .95. Direct exposure is $.95 \times .4$ equals .38 (frame building exposing B No. 1 building, table D, page 6). On account of blank wall on left side of building 3, with openings only in rear wall, exposure will be diagonal (D, page 29) or $\frac{1}{3}$ of direct (D, page 29, item c, note); $\frac{1}{3}$ of .38..... 13

Wall damage exposure to left wall of building 3 is figured from the final rate of building 2, which is 1.54 plus $33\frac{1}{3}\%$ of 1.30 equals 1.97 (D, page 9); 10% of basis rate of building 2 (C, page 24) is 10% of .82 equals .08. Excess of final rate over basis rate of building 2 is 1.97 less .82 equals 1.15; 5% of 1.15 equals .06. .08 plus .06 equals $.14 \times 80\%$ (fourth class) 11

Exposure building 4 to building 3:

Exposure standard is $33\frac{1}{3}\%$ of 1.89 equals $.63 \times .4$ (frame to B. No. 1)..... 25

Total exposure received by building 3..... 49

Exposure building 3 to row of buildings 1 and 2:

Exposure standard is $33\frac{1}{3}\%$ of .53 equals $.18 \times .3$ (B. No. 1 to frame) 05

Transmitted exposure from building 4 to buildings 1 and 2 through building 3 is .25 (see above) $\times .3$ (B. No. 1 to frame) 07

Total exposure received by row of buildings 1 and 2..... 12

Exposure building 3 to building 4:

$33\frac{1}{3}\%$ of .53 equals $.18 \times .3$ 05

Transmitted exposure from buildings 1 and 2 to building 4 through building 3 is .13 (see above) $\times .3$ 04

Total exposure received by building 4..... 09

Exposure building 7 to building 6:

Exposure is through roof of 7 into windows of 6. Standard is $33\frac{1}{3}\%$ of 1.81 equals .60; the decimal ratio of exposure standard for 5-story brick building exposing brick building is .5 (D, page 33); charge is $.60 \times .5$ 30

Exposure building 5 to building 6:

$33\frac{1}{3}\%$ of .93 equals .31; exposing building grades as "large" (D, page 32) and decimal ratio of exposure standard is .4 (D, page 33); charge is $.31 \times .4$ 12

Total exposure received by building 6..... .42

Exposure building 4 to building 5:

Wall damage only (D, page 24); basis rate of building 4 is .86; final rate is 1.89 plus .09 (see above) equals 1.98; charge is 10% of .86 equals .09 added to 5% of (1.98 less .86 equals) 1.13 or .06 equals $.15 \times 80\%$ (fourth class).... .12

Exposure building 6 to building 5:

$33\frac{1}{3}\%$ of 1.23 equals .41; the decimal ratio of exposure standard for 6-story brick building exposing brick building is .6 (D, page 33); $.41 \times .6$ equals .25; exposure is diagonal from windows in left wall of building 6 back of building 5 on 1st and 2nd stories to windows in rear wall of building 5; charge is $\frac{1}{2}$ of .25..... .12

Falling wall exposure (D, page 23), 4 stories higher, 4% of 1.23..... .05

Total exposure received by building 5..... .29

Building 7 receives no exposure.

FINAL BUILDING RATES.

Building Numbers	1	2	3	4	5	6	7
Individual rates (see above)	1.97	(row)	.53	1.89	.93	1.23	1.81
Exposure charges " "	.12		.49	.09	.29	.43	.00
Final building rates	2.09	2.09	1.02	1.98	1.22	1.66	1.81

FINAL CONTENTS RATES.

Building No. 1, Drugs, Exposure load to building is difference between individual rate of building and final rate: 2.09 less 1.54 equals .55. Exposure load to contents (D, page 9) is 90% of .55 equals .50 (D, page 9, contents removability table, fourth class, semi-removable). Rate on drugs is therefore 1.54 plus .50..... 2.04

Building No. 2, Grocery, removable (B, page 26); exposure load to building is 2.09 less 1.30 equals .79; exposure load to contents is 80% (D, page 9) of .79 equals .63. Rate on grocery is therefore 1.30 plus .63.....	1.93
Building No. 3, Bank, non-removable, in brick building, add contents differential to final building rate. D2 (A, page 29) on 1st floor is .26 (A, page 89, fourth class); 1.02 plus .26 equals 1.28 less .05 ($\frac{1}{2}$ wall damage, D, page 24).....	1.23
Dwelling, D2 (A, page 43) on second floor (A, page 89), 1.02 plus .35 equals 1.37 less .05 ($\frac{1}{2}$ wall damage, D, page 24)	1.32
Building No. 4, Meats, non-removable in frame building, add contents differential to final building rate. D3 (Butcher Shops, B, page 16) is .13 (B, page 58, fourth class); 1.98 plus .13	2.11
Dwelling, 2nd floor, non-removable, same rate as building	1.98
Building No. 5, Millinery, non-removable, D4 (A, page 61) on 1st floor, (A, page 89), 1.22 plus .41 equals 1.63 less .06 ($\frac{1}{2}$ wall damage, D, page 24).....	1.57
Tailor, removable, D2 (A, page 78) on 1st floor (A, page 89), 1.22 plus .26 equals 1.48 less .06 ($\frac{1}{2}$ wall damage, D, page 24) (no credit for removability account exposure, not including wall damage, less than .20, D, page 23).....	1.42
Plumbing, non-removable and D1 $\frac{1}{2}$ (A, page 68); 1.22 plus .21 (A, page 89) equals 1.43 less .06 ($\frac{1}{2}$ wall damage)....	1.37
Coffees and Teas, non-removable and D2 $\frac{1}{2}$ (A, page 37); 1.22 plus .34 (A, page 89) equals 1.56 less .06 ($\frac{1}{2}$ wall damage)	1.50
Lodge Hall, non-removable and D2 (A, page 50); 1.22 plus .35 (A, page 89) equals 1.57 less .06 ($\frac{1}{2}$ wall damage)....	1.51
Building No. 6, Wholesale liquors, non-removable, D2 (A, page 57) on all floors from basement to 6th; contents differential (A, page 89) is average of .35, .26, .35, .41, .47, .47 and .47, which equals .40; rate is 1.66 plus .40.....	2.06
Building No. 7, Candy factory, non-removable, D3 (A, page 34) on all floors from basement to 5th; contents differential (A, page 89) is average of .52, .41, .52, .58, .65 and 65, which equals .56; rate is 1.81 plus .56.....	2.37

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